RADIOGRAPHIC EVALUATION OF IMMEDIATELY RESTORED SINGLE-TOOTH IMPLANT IN THE ANTERIOR MAXILLA – A SIX MONTH FOLLOW-UP STUDY

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In partial fulfillment of the requirement for the degree of

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CERTIFICATE

This is to certify that the dissertation titled **"*RADIOGRAPHIC EVALUATION OF IMMEDIATELY RESTORED SINGLE-TOOTH IMPLANT IN THE ANTERIOR MAXILLA*"** is a bonafide record of work carried out by **Dr. R. SRIDEVI** during the period of 2007-2010. This dissertation is submitted in partial fulfillment, for the degree of Master of Dental Surgery awarded by Tamil Nadu Dr. MGR Medical University, Chennai in Branch I- Prosthodontics and Crown & Bridge. It has not been submitted partially or fully for the award of any other degree or diploma.

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I, **Dr.R.Sridevi**, hereby declare that the dissertation titled "**Radiographic Evaluation of Immediately Restored Single-tooth Implant in the Anterior Maxilla – A six month follow-up study"** was done in the department of Prosthodontics, Tamil Nadu Government Dental College & Hospital, Chennai -600 003. I have utilized the facilities provided by the college for this study in partial fulfillment of the requirements for the degree of **Master of Dental Surgery** in the specialty of **Prosthodontics and Crown & Bridge (Branch I)** during the course period 2007-2010 under the conceptualization and guidance of my dissertation guide, **Dr. K.S. Gamal Abdul Nasser, MDS.**

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be publicized either in print or electronic media, except for copies with those who have been actively involved in this dissertation work. I firmly affirm that the right to preserve or the permission to publish this work rests solely with the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, and it is with this vested right that I shall be cited as the author.

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CONTENTS

INTRODUCTION

INTRODUCTION

Restorative dentistry is an art that has always been blessed with the most creative, competitive minds and the technological plethora to complement them. The use of bone anchored devices as substitutes for natural teeth is not a new concept at all. As in every clinical discipline, active research in this field has led to the introduction and development of dental implants that have raised the bar for patient treatment. A dental implant is a prosthetic device made of alloplastic material(s) implanted into the oral tissues beneath the mucosal or/and periosteal layer, and on/or within the bone to provide retention and support for a fixed or removable dental prosthesis (GPT-8)[69]

The more useful a technology, the more rapidly are its limits challenged by the user, in turn, user demand drives the necessity for refinements and improvements. Thus the last few decades have seen an increasing use of endosseous implants as a means of providing a foundation for intra-oral prosthetic devices from full arch dentures[1], single crowns and fixed partial prosthesis[4], to devices for distraction osteogenesis[43]. The precursor to the modern endosseous implant was the spiral screw designed by Formaggini in 1948. But the true pioneer for their success today is Per Ingvar Branemark. Brånemark placed his first clinical oral implant in 1965. In the following 5 years, his clinical results were also unacceptably poor, with success rates of about 50%. Brånemark's early results seemed to confirm that foreign materials did not work in the oral cavity. Slowly, clinical outcomes for patients with Brånemark's

implants clearly improved, not as a result of traditional controlled trial research but in an empirical manner with the simultaneous changing of a great number of parameters. Implants were made wider with some design enhancements and changes were made to the surgical and prosthodontic routines. Implant healing time was prolonged, 3 months for the mandible and six months of undisturbed healing for the maxilla –'The submerged, two-stage protocol'. The success of this procedure was documented and the term Osseointegration, first coined in 1977[C1] - A process whereby clinically asymptomatic rigid fixation of alloplastic materials is achieved and maintained in bone during functional loading (George A Zarb-1991) [C6].

The treatment of patients ad modum Branemark was initially applied to completely edentulous patients only. The application of this protocol to partially edentulous patients raised a lot of questions, say for example - Can the reduced freedom of location for the fixtures increase potential failure during surgery? Twenty years down the lane, an implant retained restoration is the treatment of choice for single tooth replacements in the esthetic zone[63]; and success of the restoration is rated not just based on the achievement of osseointegration but also in terms of its esthetic outcome. Not only has the scope of patient treatment widened; increasing clinical acumen and improved implant surface structures have shifted the treatment platform from delayed to immediate loading protocols wherein an implant can be loaded right on the day of surgery or within 48 hours[23].

It would be erroneous to assume that the concept of immediate loading evolved following the indisputable success with Branemark implants, it in fact belongs to the preosseointegration era. The famous 'Linkow blade' first placed in 1968 was loaded immediately with a complete denture prosthesis and was known to remain in good function for over twenty years. Today, the application of immediate load to endosseous implants is not as crude, and has stemmed from technological advancements in the design and texture and constant revision of existing protocols and surgical technique. The resurgence of interest in immediate loading was brought about by the introduction of transmucosal one piece/ two-piece screws by Schroeder and Ledermann in Germany in 1981[C2]. But it was only in 1988, with the help of Buser, did they convince the community that transmucosal implants could be used predictably to retain a restoration. This was in direct conflict with the Branemark submerged protocol. The ITI system and Buser became the real scientific contenders of the work of Branemark. In addition, through the years, focus on joint design, screw design and material properties all led to explosive development in this area of implantology. These improvements in design helped achieve the most important prerequisite for loading an implant immediately and achieve Osseointegration despite the constant infraction of the titanium-bone interface – 'Primary stability'. Thus immediate loading is no more beyond reach but a possible, viable alternative that involves astute treatment planning and meticulous technique. Controlled clinical trials have documented the success of the one-stage protocol not only in the completely edentulous scenarios but also the partially edentulous and single tooth replacement ones.

Originally, immediate loading was intended for the transmucosal (one stage) implants – either one piece or two-piece. But increasing demands have made available, two stage implants amenable to immediate loading. It is said that the one piece implants have the advantage of eliminating the implant abutment junction which is the harbor for pathogenic microflora and minimizing the crestal bone loss by eliminating the micromovement associated with the interface. On the other hand, studies have shown no significant difference in the use of immediate loading with the one stage or two-stage implants. Thus, variety is with the market and the choice with the clinician! Despite the availability of various diagnostic tools that aid in presurgical treatment planning, at times the decision to load an implant immediately maybe a chair side one. In this context, two-stage implants bestow the clinician with better treatment flexibility.

The restorative protocol in this study is Immediate Non Occlusal Loading (INOL) protocol. Also known as Immediate Restoration of the implant wherein the implant is placed and the abutment connected on the same day in a single stage. This interim abutment is utilized to support a provisional prosthesis out of occlusal contact that is luted in place within the first 48 hours after surgery. Utmost care is taken that the restoration is relieved of all occlusal contacts – both centric and eccentric. This modality has the clinical advantage of increasing patients' acceptance of oral implants as the fixture is provisionalized immediately; this is a sensitive issue especially when the protocol is applied to the esthetic zone. It also involves a single surgical phase, thereby eliminating the additional surgical trauma the patient is subjected to in the

second surgical phase. The overall treatment time is reduced in terms of soft tissue healing and maturation. The esthetic result is superior because the provisional crown allows for 'prosthetically guided' healing of the healing of the soft tissues [58]. The surgical technique in this study was further modified to suit the patient's comfort into a flapless surgery with ridge expansion osteotomy.

In the restoration of patients with implants in the esthetic zone, it can be said that there are two basic criteria for evaluating treatment outcome. Number one – If the implants have osseointegrated or not following a stipulated healing period; and number two – if the restoration is a functional and an esthetic success. The esthetic success, apart from the shade, shape and form of the restoration, lies in the harmonious draping of healthy soft tissue over the restorative margins and maintenance of the interdental papilla between contact points. The most primitive determinant of adequate soft tissue drape is proper three dimensional implant positioning. This being ensured, soft tissue is maintained only when the underlying bone levels are steady. It is the marginal bone surrounding the implants that provide the stable, hard tissue foundation for the soft tissue. There exist both two dimensional and three dimensional radiographs to assess bone loss. The bone loss on the buccal and lingual dimensions can be assessed only on a three dimensional radiograph. A 2-d representation like a digital intraoral radiograph provides information only on the interproximal bone. However, the changes occurring on the interproximal bone are the ones that have been used to qualify the success of an implant treatment protocol in most studies[15, 22, 24] with reference to the criteria established by *Albrektsson et al*[2].

The technique used for evaluation of bone loss in this study is digital subtraction of two dimensional images to determine the difference between two images taken for the same patient; one on the day of surgery as reference and the other at the end of the follow up period. Subtraction radiography uses standardized radiographs taken at two different examinations. All structures that have not changed between examinations, such as the implant, are displayed as a neutral background in the resultant subtraction image. By convention, areas of bone loss are shown in dark shades of gray. *Webber et al.*, 1982[C5]; *Ortman et al.*, 1985[C3] were among the ones to introduce Digital Subtraction Radiography, utilizing digitized intra-oral radiographs, to dentistry. This technique has been shown to improve significantly detection of artificially induced bony changes as small as 1 to5%. Jeffcoat et al [41] provided validated data to support that digital subtraction radiography can be used for precise measurement of bony change.

This study aims at determining the amount of crestal bone loss around single-tooth implant restored with the Immediate Non-Occlusal Loading protocol/ Immediate restoration protocol in the anterior maxilla over a six-month follow-up period using digital subtraction radiography.

AIMS& OBJECTIVES

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This six month follow-up study on the radiographic bone loss following immediate restoration of single tooth restorations in the maxillary anterior esthetic zone aims to

1. Determine the course of healing and progression following immediate restoration.

2. Evaluate the radiographic crestal bone loss in the 6-month period with the reference bone level as reference.

3. Determine the outcome of the implant-retained restoration in terms of functional and esthetic success.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

This literature review is presented in four parts,

1. From delayed to immediate loading of single tooth implants in the esthetic zone
2. The rationale behind immediate loading
3. Surgical and implant macro geometry considerations
4. Crestal bone loss, its assessment and implications

Key words: single tooth implants, esthetic zone, immediate restoration, success rates, micromotion, stress transfer, primarily stability, surgical trauma, implant design optimization, crestal bone loss, digital subtraction radiography.

FROM DELAYED TO IMMEDAITE LOADING OF SINGLE TOOTH IMPLANTS IN THE ESTHETIC ZONE

The original implant treatment protocol, as described by ***Brånemark et al*** (1977) [C1] required a two-stage surgical protocol, healing period of three months for the mandible and six months for the maxilla before loading. The healing period provided a time of nonfunction to ensure that osseointegration of the implants occurred. The restorative goal was usually the placement of an implant-supported mandibular prosthesis.

***Ledermann* (1979)** [C2] suggested that the crucial factor for successful osseointegration was the stability of the implant during the healing phase such that any motion at the bone-to-implant interface was below a certain threshold.

Daniel van Steenberghe *(*1990)[18] first studied the success rate (91.6%) in treating partially edentulous patients with implants.

Jemt et al (1991)[70] stated that the one-year failure rate for implants in the esthetic zone were low (2.8%) and coincided well with other short-term results for partial as well as completely edentulous patients. Yet, he believed that patient selection criteria for single fixtures supporting dental restorations involved additional concerns that must be addressed.

Buser et al (1991)[17] evaluated the tissue integration on one-stage ITI implants. 51/53 (96.2%) fixtures integrated successfully and maintained the integration for three years.

David. L. Cochran et al (2004)[19] – Consensus definition of immediate restoration – A restoration inserted within 48 hours of implant placement but not in occlusion with the opposing dentition.

Immediate loading – A restoration placed in occlusion with the opposing dentition within 48 hours of implant placement.

Momen A Atieh (2009)[60] states "The application of immediate loading protocols to single implant crowns was seen as more challenging than multiple implants in partially and totally edentulous arches since they lack the mutual or cross arch stabilization."

Currently, sufficient data are available to support the concept that immediately restored implants in single tooth situations in the esthetic zone can achieve integration using many implant systems and protocols (***E.Hui et al*** (2001)[22], ***E. Anderson et al*** (2002)[26]).

PERIIMPLANT HEALING - RATIONALE FOR IMMEDIATE LOADING

The goal of modern implant dentistry – *"Osseointegration"* is essentially an interfacial healing phenomenon that is currently defined as "A process whereby clinically asymptomatic rigid fixation of alloplastic materials is achieved and maintained in bone during functional loading."***George.A.Zarb*** (1991). [C6]

H.Weinans et al (1993)[31] stated that the relative micro motion and stresses at the interface are controlled by various factors such as i) Implant geometry and material properties and ii) patient factors such as magnitude of load applied, bone quality and quantity, resorption threshold. The two factors interact and control the interfacial disruption and resorption of bone.

Szmukler-Moncler et al (1998)[66] suggested that the specific histologic response of early loaded implants, i.e. fibrous repair or osseointegration were directly related to implant design, prosthetic reconstruction and by their ability to introduce a distinct magnitude of motion at the interface.

Only excessive micromotion was directly implicated in the formation of fibrous encapsulation. The critical level, however, was not zero micromotion as generally interpreted. Instead, the tolerated threshold was found to lie somewhere between 50 and 150µm.

According to ***John B. Brunski*** (1999)[45], Micromotion probably interferes with development of an adequate early scaffolding from a fibrin clot, and disrupts the re-establishment of a new vasculature to the healing tissue, which in turn interferes with the arrival of regenerative cells.

In examining the biological cascade of early peri-implant bone healing, ***John E Davies*** (2003)[46] stated that by the time bone is formed on the implant surface, the most important healing events have already occurred.

Current implant surface designs, in order to ensure early stability aim at optimizing contact osteogenesis, i.e. recruitment of differentiating osteogenic cells onto the implant surface to promote *de novo* bone formation

U. Meyer et al (2004)[71]- Micromotion at the implant/bone interface can have two principal effects on the cellular and extracellular components of bone. First the micromotion can lead to a disruption of the bone-cell/implant contacts and therefore has the ability to disturb the cell reaction by a detachment; or second the micromotion can lead to a deformation of osteoblasts fixed to the surface in a strain related manner.

J Duyck et al (2006)[38] – Immediate loading of the healing interface leads to both micromotions at the bone-implant interface and the transfer of forces to the surrounding tissues.

Measures to reduce micromotion

When immediate non-functional loading was compared with immediate loading in a controlled study, immediate non-functional loading increased the implant survival rate – ***Degidi & Piatelli*** (2003)[56]

In addition, rough surfaced implants showed a better survival rate compared with machined implants when immediately loaded – ***Rocci et al*** (2003)[6]

Abrahamsson et al (2004)[36] speculated that the increased proportion of bone-implant contact observed next to rough-surfaced implants may, indeed, provide an earlier and better anchorage of devices, thus allowing for an earlier functional loading of implants.

Jaffin et al (2004)[65] suggested a 400 HU density threshold for implant placement.

Passive fit of the provisional prosthesis also has been mentioned as an important factor. According to *Jaffin et al*, a prosthesis that is ill-fitting may become loose resulting in increased stress on the implants, which can lead to excessive micromotion and loss of an implant.

Ottoni et al (2005)[48] stated "The achievement of high insertion torque is likely related to the achievement of higher primary fixation. Their study concluded that immediate loading in single tooth restorations should only be considered if the implant can be placed with an insertion torque greater than 32Ncm

A biomechanical study by ***Kivanç Akça*** *et al* (2006)[49] explored the effect of bone micromorphology on intra osseous stability of implants. Implant Stability Quotients (ISQ) and Insertion Torque Values (ITV) were measured and were evaluated for correlations with bone volume fraction. As implant stability, either primary or secondary, is ultimately related to bone-implant contact *per se* bone-implant interface, a measurement that reveals this relation is of utmost importance. They concluded that "ITV is more sensitive in terms of revealing the biomechanical properties (mechanical stability) at the bone-implant interface in comparison with ISQ.

Misch et al (2008)[14] – Initial bone density provides mechanical stabilization of the implant during healing. Also denser bone provides greater bone to implant contact. In order to increase the implants resistance to movement, implants were placed preferentially in regions with high bone density.

Optimizing stress transfer

C.E.Misch et al (2004)[13]

Higher micro strains in bone result in more reactive woven bone, which is weaker and has a lower modulus of elasticity. One method to decrease the strain is to decrease the stress to the implant and/ or prosthesis. Stress equals force divided by area. As a result, conditions that increase the area of support in the bone or methods to decrease the force to the prosthesis are appropriate. Area may be increased by implant number because a number of implants splinted together results in a greater surface area and decreases the risk of overload to each implant.

Area of load may also be increased by implant size, implant design, and implant surface condition. In addition, stresses may be reduced by decreasing the force applied to the prosthesis. Forces may be influenced by patient factor, implant position, cantilever forces, occlusal load direction, occlusal contact positions and diet.

SURGICAL, IMPLANT MACROGEOMETRY CONSIDERATIONS

Minimizing bone damage, Maximizing implant stability

Eriksson RA (1983)[25] reported bone cell death when a temperature of 40ºC was applied for 7 minutes, or when a temperature of 47ºC was applied for 1 minute. In other words, time and temperature are interrelated critical factors in implant site preparation.

Lee H Silverstein et al (1999)[50] stated that the 'Ridge expansion technique osteotomes conserved bone. In addition, the osteotome technique is essentially heatless and therefore should not destroy the viable bone-forming cells."

Jack Hahn (1999)[40] – If bone condensation is desirable, Types III and Type IV ($D_{3,}$ D_4) are best suited.

Martinez et al (2001)[33] – The osteotome technique has been described by Summer's in 1994. The objective of this method is to preserve all the existing bone by minimizing or even eliminating the drilling sequence of the surgical protocol. The bone layer adjacent to the osteotomy site is progressively compacted with various bone condensers (osteotomes). This will result in a denser bone to implant contact. This improved bone density helps to optimize primary stability even in low density bone.

Misch et al (2004)[13] – The implant body design should be more specific for immediate loading. This is even more important for immediate load in single tooth applications and restoration replacing only a few teeth. A threaded implant design may have some bone present in the depth of the threads from the day of insertion. Therefore, the functional surface area is greater during the immediate load format. As a result, threaded implants present considerable advantages or immediate load protocols, because their design features do not require integration to resist loads and they also have greater surface area to resist occlusal forces.

In addition, ***O' Sullivan et al*** (2004)[21] in analyzing the stability characteristics of cylindrical and tapered endosseous implants arrived at the conclusion that 1° taper resulted in better primary stability. The theory behind this is the induced degree of compression during placement of a tapered implant, especially in a poor bone implant site.

Hom-Lay Wang et al (2006)[35]– arrived at a consensus that the implant length better suited for immediate loading was ≥10 mm and that a minimum of 3.5mm diameter is required.

Misch et al (2008)[14] – The density of available bone in the edentulous site has a primary influence on treatment planning, implant design, surgical approach, healing

time and initial progressive bone loading. The quality of recipient bone directly influences the amount of trauma generated during osteotomy preparation.

Jack A Hahn (2009)[39] – in discussing the concept of the tapered design, said that the tapered design works in harmony with the anatomical constrictions of the jaws. Tapered shape often requires fewer drilling steps and allows for the placement of a wider cervical diameter implant in more favorable positions, without having to tilt the implant more than an average of 15 degrees. Increasing the cervical diameter offers a wider prosthetic platform for the restoration, which results in less stress to the crestal bone. Having the ability to place an implant in a more favorable position for the prosthesis is also an important factor in reducing stress.

OUTCOME EVALUATION OF IMMEDIATE RESTORATION OF SINGLE TOOTH IMPLANTS IN THE PREMAXILLA

A number of authors (***Gomes et al*** 1998[4], ***E. Hui et al*** 2001[22], ***Chaushu et al*** 2001[30], ***Proussaefs et al*** 2002[62], ***Andersen et al*** 2002[26], ***Lorenzoni et al*** 2003[57], ***Tsirlis et al*** 2005[3], ***Marco Degidi et al*** 2006[54], ***Kan et al*** 2007[47], ***Marco Degidi et al*** 2008[55],***Riberio et al*** 2008[27], ***Marco Degidi et al*** 2009[53]), in studying the outcome of immediate restoration of single tooth implants have reported the success rates of hundred percent with a follow up period ranging from 6 months to 5 years for this procedure. Sample sizes ranged from 1-44 implants in various regions of the jaw in patients of different age groups.

In the study by ***Ericsson et al*** *(*2000)[24], two fixtures were removed after 3 and five months due to absence or loss of osseointegration (CSR = 85.7%).

The author exclaims "The reason for these two fixture losses can only be speculated upon. However, it has to be mentioned that, one of these two patients showed a massive plaque accumulation when the fixture was diagnosed mobile, and in the other one a very hard and dense bone was noted during fixture installation."

The survival rate (96.2%) in the study by ***Cooper et al*** (2001)[52] was independent of implant length, tooth position, bone quality and quantity. One implant failed three weeks following surgery following provisional restoration placement. Another implant failure was determined prior to impression for an all-ceramic crown.

The study by ***Buchs et al*** (2001)[5] observed the highest number of failures in Type IV bone followed by Type I bone. The high success rates (CSR = 95%) were attributed 'a new thread design'; good communication and case selection.

Paulo Malo et al (2003)[61] deduced a success rate of 93.7% for unsplinted single implants in contrast to 98.1% for the splinted ones. 3/4 failures were in the maxillary anterior region and occurred at 3, 5 and 6 months. All failures occurred in Type 2, 3 bones and before the final prosthesis were made. It could be speculated that the reason for failures was that the implants never became integrated.

Carl Drago et al (2004)[15] in his study with a Cumulative Survival Rate of 97.4%, identified that the success of the immediate restoration protocol include primary implant stability, elimination of occlusal contacts prior to osseointegration, dietary modifications during the initial healing period.

Michael Norton et al (2004)[59], in his sample of 12 immediately restored patients, one patient presented at the one-month review complaining of mobility (CSR = 91.6%). She habitually protruded her mandible and thus had difficulty avoiding loading the provisional crown.

Lindeboom et al (2006)[44] compared the survival rate of immediately loaded (91.6%) and immediately provisionalized (88%) maxillary single tooth replacements. He found no statistically significant differences between the two groups.

He stated that "In immediate loading or immediate provisionalization, an important uncontrolled determinant was the role of the patient. Although differences in success percentage could be due to differences in inclusion criteria or differences in implant surface characteristics, no attention is paid to the role of the patient after the delivery of the temporary crown.

The role of tongue pressure and perioral musculature may be an underestimated factor in immediately provisionalized and nonleaded implants. Moreover, occlusion might not be the only determinant of implant success.

CRESTAL BONE LOSS, ITS ASSESSMENT AND IMPLICATIONS

Among the ones who introduced digital subtraction radiography to dentistry ***Jeffcoat MK et al* (1987)**[42] showed that the technique is of value for the detection of small osseous changes which may occur between two radiographic examinations.

Albrektsson et al (1989)[2] established criteria implant success as follows

1. An individual unattached implant is immobile when tested clinically
2. A radiograph does not demonstrate any evidence of periimplant radiolucency
3. Vertical bone loss is less than 0.2 mm annually following the first year of service of the implant and not more than 1.5 – 2mm from the Implant Abutment Junction during the first year
4. Individual implant performance is characterized by an absence of persistent or irreversible signs and symptoms such as pain, infections, neuropathies, paresthesia, or violation of the mandibular canal.
5. In the context of the foregoing, a success rate of 85% at the end of a 5-year observation period and 80% at the end of a 10-year period are the minimum criteria for success.

Digital subtraction radiography was proposed as a potential diagnostic tool for implant research and patient monitoring by ***Bragger et al*** (1991)[72]. The diagnosis of peri-

implant tissue changes calls for sensitive radiographic techniques to assess any subtle peri-implant bone changes. Resorptive bone changes are considered to be a sign of progressing peri-implantitis which could lead to loss of osseointegration. The extent of such resorptive changes and the level at which osseointegration is still present may be identified in digital subtraction images. As a prerequisite for digital subtraction radiography, standardized radiographs must be obtained with great accuracy. For each site under observation, bite blocks were fabricated to facilitate identical exposure geometry.

Bone invariably resorbs all the way down to the rough-smooth transition line and subcrestal placement of the border between the two surfaces resulted in increased loss of bony support during the first year of service – ***Hammerle et al*** (1996)[32].

Tarnow et al (2000)[67], the horizontal component of the biologic width amounts to 1-1.5mm. Maintain minimal tooth-implant/ interimplant distance of 2-3mm

Tarnow et al (2003)[20] – the optimum vertical distance between the bony base of the papilla and the contact point of the superstructure is 5 mm if papilla and marginal bone are to be preserved

Lazzara et al (2006)[64] Histological and radiographic observations suggest that a biologic dimension of hard and soft tissues exists around dental implants and extends

apically from the implant abutment interface. Radiographic evidence of the development of the biologic dimension can be demonstrated by the vertical repositioning of the crestal bone and subsequent soft tissue attachment to the implant that occurs when an implant is uncovered and exposed to the oral cavity. He also went on to prove that this postoperative biologic process is altered when the outer edge of the implant-abutment microgap is horizontally repositioned inwardly away from the outer edge of the implant platform.

Fredrick Hermann et al (2007)[28] said – A stable bone level around an implant neck is a prerequisite for achieving support and, hence, long-term optimal and stable gingival contours. This is especially so with regard to the interdental papillae in the anterior region. . This stable bone then serves to support the soft tissue, determining the long-term esthetic and functional treatment outcome.

The author suggests that crestal bone remodeling will progress until biologic width has been created and stabilized. Not only does this width progress apically, along the vertical axis, but according to studies conducted by Tarnow et al also has a horizontal component. Current trends in implant design favor reduction or elimination of the smoothly polished segment of the implant. An additional advantage of fine threads along the implant neck is that the thread stabilizes the implant, contributing to primary stability

C. E. Misch (2008)[14] Bone loss has been described in the crestal region of successfully osseointegrated implants regardless of surgical approach. It can range from marginal bone loss to complete failure of the implant.

The current hypothesis for the cause of crestal bone loss have ranged from reflection of the periosteum during surgery, preparation of the implant osteotomy, the position of the microgap between the implant body, micromovement of the abutment components, bacterial invasion, the establishment of biological width, and factors of stress. The effects of crestal bone loss may range from early failure of implants (especially in soft bone or short implants) to esthetic complications and periimplant disease. According to the author, the consequences of marginal bone loss are such that all phases of implant dentistry, from diagnosis and treatment planning to final stages of occlusion and prosthesis delivery, must focus on its reduction or elimination.

The International Congress of Oral Implantologists Pisa Consensus Conference, ***Carl E. Misch et al*** (2008)[12] considered the marginal bone around the implant crestal region a significant indicator of implant health.

The bone loss assessed should be related to the original bone level at the implant surface, rather than to a previous level. The most common method to assess marginal bone loss is with a conventional radiograph. Although this only determines the mesial and distal bone loss, it is a time-tested method.

The consensus on successful implants (Group I on the quality health scale) includes, no pain observed with palpation, percussion or function. No clinical mobility is noted

in any direction with loads less than 500 g. Less than 2.0 mm of radiographic crestal bone loss is observed compared with the implant insertion surgery. The implant has no history of exudates.

In a systematic review of literature by ***Ingemar Abrahamsson et al*** (2009)[37] found that no implant system was found to be superior in marginal bone preservation.

Xi Ding et al (2009)[74] in an FE model study derived that increasing the length and diameter of implants decreased stress and thereby bone loss on the alveolar crest. Diameter had a more significant effect than length. The stress and strain values notably increased under buccolingual loading as compared with vertical loading.

In a study on the effect of Implant design and surface roughness of the collar on crestal bone levels in the esthetic zone, ***E.Stein et al*** (2009)[8] concluded that bone loss was greater in the smooth, stepped collar design when compared to rough and straight collars. Also, the crestal bone position relative to the implant at the time of surgery influenced mean bone level changes significantly.

In a review of relevant literature, ***Teughels et al*** (2009)[68] suggested that "The esthetic outcome in the interproximal region of teeth and implants is primarily determined by the presence, height, form, color and symmetry of the papilla. Because many of these

factors are not taken into account in studies on the esthetic outcome of implant therapy, papillary fill was used as a surrogate measurement for esthetic outcome in relation to interproximal bone dimensions.

MATERIALS & METHOD

MATERIALS AND METHOD

I ARMAMENTARIUM

A. SURGICAL ARMAMENTARIUM

1. Sterile patient drapes
2. Sterile Towels
3. Sterile gauze, cotton
4. Mouth mirror, probe
5. Head cap, face mask and sterile gloves
6. Disposable syringe and needle
7. 2% Lignocaine with adrenaline anesthetic solution
8. Implant Surgical motor (Confident Dental Equipments, Banglore)
9. 20:1 High Speed contra-angle hand piece (NSK, Nakanishi Inc, Japan)
10. Hand piece sleeve – sterilized
11. Betadine
12. Normal Saline
13. Gingival Punch – 5.2 mm wide R*p* – Regular platform (Nobel Biocare)
14. Gracey Curette
15. Curved Artery Forceps – 6" – 2 Nos
16. Straight Artery Forceps – 6" – 2Nos.
17. Mosquito forceps, straight – 2 Nos.
18. Mosquito forceps, curved – 2 Nos.
19. Access drill – 2 mm (Nobel Biocare, Göteborg, Sweden)

20. Sequential tapered Osteotomes – 2.5mm, 3.0 and 3.5 mm (Nobel Biocare, Göteborg, Sweden)
21. Mallet
22. Two-piece Implant (Nobel Replace Select N_P-3.5×13mm) – 1 No (- Nobel Biocare, Göteborg, Sweden)
23. Two-piece Implant (Nobel Replace Select - N_P 3.5×16mm) – 3 No's (Nobel Biocare, Göteborg, Sweden)
24. Direction indicator
25. Implant hex driver (Nobel Biocare, Göteborg, Sweden)
26. Surgical adapter
27. Calibrated toggle type torque wrench (Nobel Biocare, Göteborg, Sweden)

B. PROSTHETIC ARMAMENTARIUM

1. Permanent Easy abutment – 3No's (N_P - Nobel Biocare, Göteborg, Sweden)
2. Permanent Esthetic abutment – 1 No. (N_P - Nobel Biocare, Göteborg, Sweden)
3. Unigrip Screw Driver – Prosthetic (Nobel Biocare, Göteborg, Sweden)
4. Screw driver Unigrip machine
5. Calibrated toggle type torque wrench (Nobel Biocare, Göteborg, Sweden)
6. Screw Access Channel plug

7. Periodontal Probe
8. Petroleum Jelly
9. Polycarbonate Shells
10. Tooth-colored autopolymerizing resin polymer
11. Repair resin polymer
12. Autopolymerizing resin Monomer
13. Dapper dish
14. Wax knife
15. Wax carver
16. Bard Parker blade No.15 and Handle
17. Articulating paper forceps
18. Articulating paper
19. Temporary cement
20. Impression transfer coping (N_P - Nobel Biocare, Göteborg, Sweden)
21. Implant Analog (N_P - Nobel Biocare, Göteborg, Sweden)
22. Monophase PolyVinyl Siloxane (Aquasil, Dentsply Caulk)
23. Type IV dental stone
24. Instruments for Metal Ceramic crown fabrication

C. RADIOGRAPHIC ARMAMENTARIUM

1. IOPA RadioVisioGraphy Sensor (Kodak Eastman Company)
2. Long Cone X Ray tube

3. Sensor Positioning Device (Hawe X Ray sensor holder system, Pinnacle products Inc, Leakesville)
4. Patient Head Positioner
5. PolyVinyl Siloxane Putty (3M ESPE)
6. Personal Computer
7. Software – (Adobe Photoshop CS4 Extended, Adobe Inc, San Jose, CA)

II **METHODOLOGY**

Following approval from the institutional ethical committee, four male patients ranging in age from 20-28 years were recruited from the outpatient department in Tamil Nadu Government Dental College, Chennai for the study

The entry criteria included the following:

1. Healthy male patients, age range 20-30 years
2. Single missing upper Central Incisor – either 11/21
3. Healed site – minimum 6 months post extraction
4. Minimum crestal bone width of 4.0 mm
5. D_3 bone density
6. Agreed to follow-up for 6-months
7. Signed surgical consent forms

Exclusion criteria included the following

1. Any systemic disorders
2. Poor oral hygiene
3. Parafunctional Habits
4. Smokers
5. Surgical site requiring bone augmentation or grafting
6. Traumatic occlusion

The purpose of the study and the importance of strict adherence to follow-up schedules were explained to all patients, and surgical consent forms were signed.

Two-piece implants amenable to immediate loading (Nobel Replace Select) were selected according to the available length and width of the residual ridge. Three on four patients received an implant measuring 3.5 mm × 16mm and one patient received a 3.5 × 13 mm implant. The treatment protocol for all four patients involved Immediate Restoration following delayed implant placement also known as Immediate Non-Occlusal Loading (INOL) protocol.

PREOPERATIVE PREPARATION

All four patients underwent thorough oral prophylaxis and polishing. One patient underwent composite restoration of his fractured lateral incisor 22 and a Class VI defect in 11.

Preoperative records

1. Study casts
2. Preoperative photographs
3. Routine blood investigations
4. Distortion corrected Panorographs
5. Computed Axial Tomographic Scans (*Courtesy – TNMSC, Department of Radiology, Madras Medical College, Chennai*) were taken to measure the buccolingual width and bone density at the proposed implant site.

SURGICAL PROCEDURE

One hour prior to surgery, one gram of amoxycillin and 400mg Ibuprofen were administered orally or prophylaxis. Patients were adequately prepared and anesthetized with 2% Lignocaine with adrenaline anesthetic solution. A 5.2 mm wide gingival punch (R*p* – Regular platform) was used to punch the mucosa at the proposed osteotomy site – the centre of the edentulous ridge. This constitutes the flapless technique of ridge exposure for implant placement. The punch used should be at least 1mm greater in diameter than the implant to ensure adequate surgical access[51]. Following punch elevation of the mucosa, a measurement was made from the mucosal margin to the crestal bone and this measurement was used to determine the appropriate osteotomy depth. The depth of the final osteotomy equaled the length of the implant plus the thickness of the mucosa at the crest. If the planned implant length was 16 mm and the thickness of the mucosa was 2 mm, the osteotomy was prepared to 2mm below the 16 mm line on the access drill. This allowed the head of the implant to be placed 2 mm below the mucosal margin. Among the four patients, one patient received a 13 mm implant and the three other implants were 16 mm in length. The drilling was accomplished under copious external irrigation with normal saline to minimize thermal necrosis of the bone. Drilling speed was slow (850- 900 rpm), with minimal pressure, and intermittent removal of the drill from the preparation site to minimize surgical trauma to the surrounding bone. The orientation of the osteotomy is checked with the direction indicator. Following initial access osteotomy, the residual ridge was expanded with the help of sequential tapered osteotomes (Nobel Biocare, Göteborg, Sweden); first by tapping a 2.5 mm wide osteotome to the depth of the

initial osteotomy which was later followed by a 3.0 mm tapered osteotome and finally 3.5 mm.

Surgical Manual Torque Wrench: The Surgical Manual Torque Wrench and Surgical Adapter are required to place the implant in the osteotomy site. The implant hex driver is mounted on the surgical adapter and the tip of the implant driver is used to engage the implant and pick it up from the inner sterile titanium cylinder package. The implant was torqued to its final depth. All implants achieved a final insertion torque of ≥32 Ncm. Care was taken to avoid exceeding the 45Ncm implant torque mark on the wrench.

Implant Orientation: Align one of the dimples on the implant driver perpendicular to the buccal/facial wall. This positions one lobe of the internal connection buccally for ideal prosthetic abutment orientation.

Following implant placement, an appropriate abutment was selected based on the periimplant sulcular depth; when the sulcular depth was ≥ 4 mm, an intermediary abutment that raised the prosthetic platform to within 2-3mm of the soft tissue margins was used. The appropriate abutments were connected and their complete seating verified when the flat side of the abutment is oriented in line with the apex of the trichannel on the buccal side. Once verified, the abutment screw is tightened with a Unigrip screw driver and final tightening with the Manual Torque wrench and and screw driver Unigrip machine to a torque of 25-30 Ncm to minimize the incidence of screw loosening. Patients were asked to continue medication 72 hours post surgery in

the dosage of Cap. Amoxicillin 500mg T.D.S, Tab Ibuprofen 400 mg B.D and Tab Paracetamol 500mg T.D.S

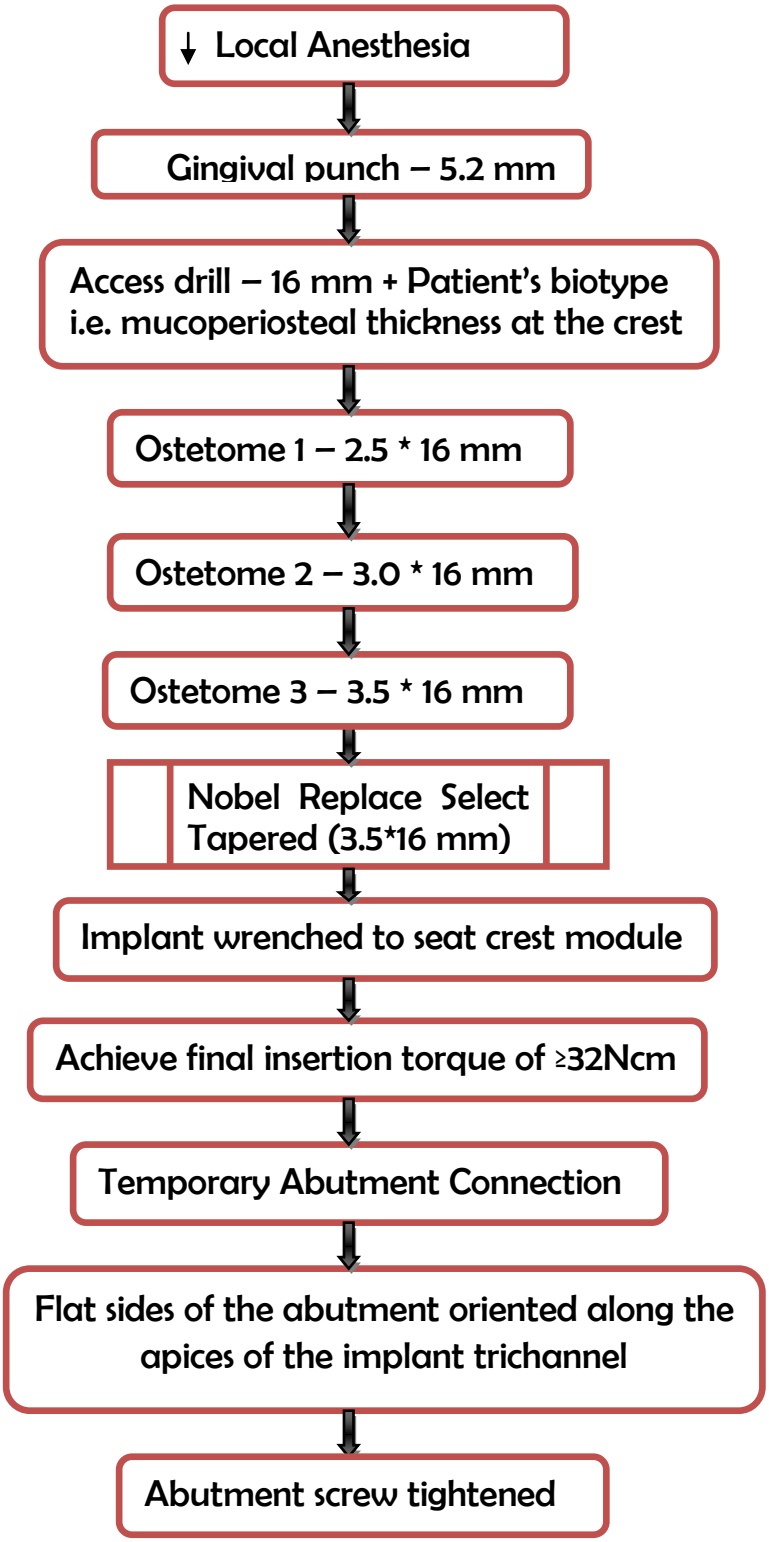
PROSTHETIC PROTOCOL - Provisional Restoration **(≤ 48 hours post surgery**)

The achievement of adequate primary stability made immediate restoration of the implant possible. Polycarbonate shells for provisional restoration of maxillary central incisors were tried in and contoured. The screw access channel of the easy abutment was blocked out with the included screw access plug using a periodontal probe in the small hole in the center of the plug.

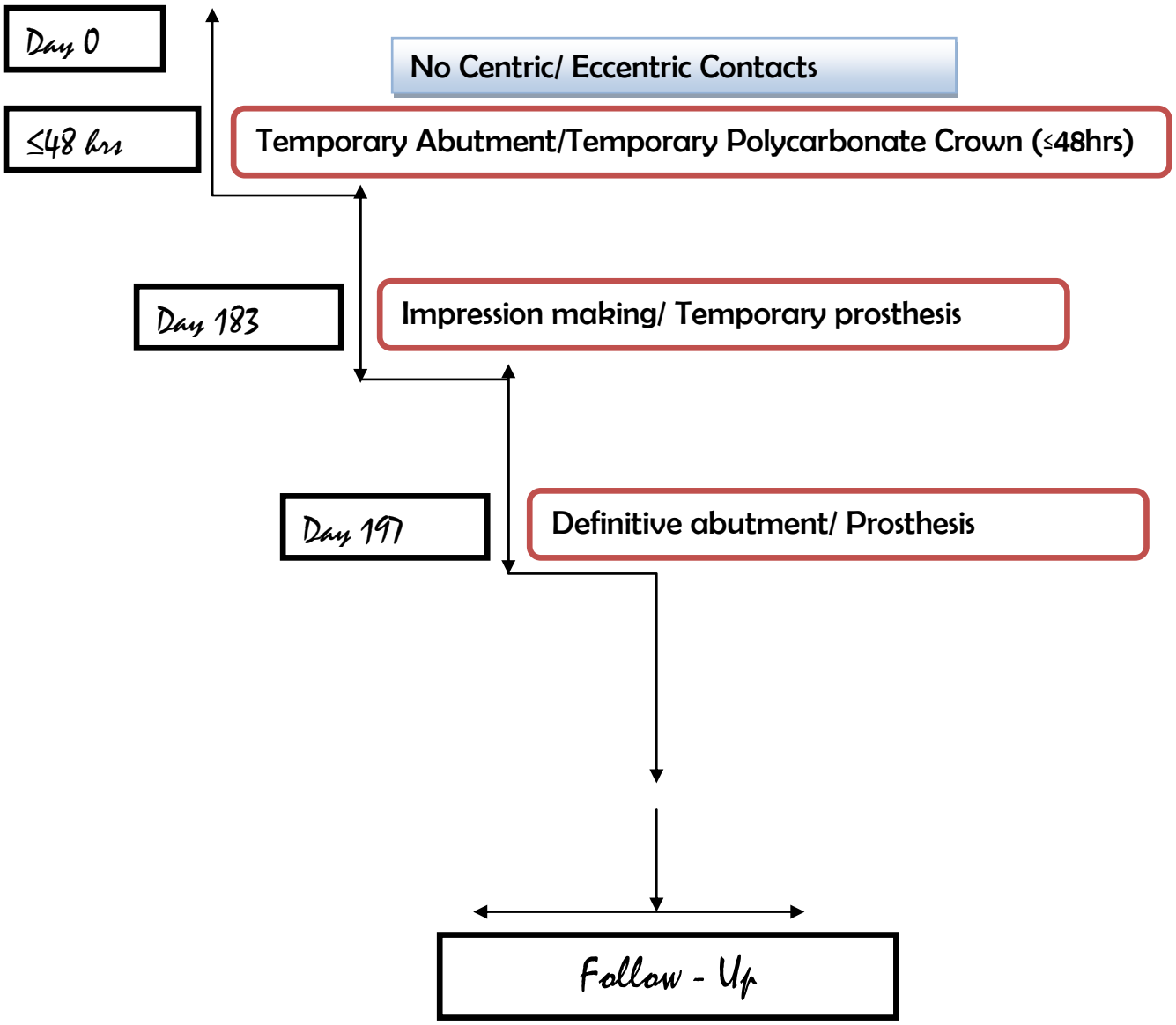
A coating of petroleum jelly applied for separation. The contoured polycarbonate shell was relined with autopolymerizing acrylic resin and allowed to set around the greased superstructure. The relined shell was trimmed, verified for fit and finished. The provisional restoration was luted with temporary cement (Zinc oxide Eugenol). Utmost care was taken to avoid any contact on the provisional restoration – centric or eccentric.

Surgical Protocol – Immediate restoration

Flapless Single-Stage Surgery - *Procedural Flow Chart*



Prosthetic Protocol – Immediate NonOcclusal Loading(INOL)



POSTOPERATIVE INSTRUCTIONS AS GIVEN TO THE PATIENT

1. Fill the prescription and follow the instructions on the label

2. Apply ice wrapped in a cloth to your face 10 minutes on and 20 minutes off for 24 hours.

3. To 1 quart of tap water, add 1 teaspoon of common salt, mix. Bring to boil, store in a covered container. Use as a gentle irrigant, 8 ounces each hour. Start the next day and continue until sutures are removed

4. Eat very soft foods as tolerated. They should be of high protein content.

5. For the first 24 hours postoperative, drink plenty of fluids, juice, soda, water, milk.

6. Take two tablespoons of milk of magnesia on the night of surgery.

7. Expect a good amount of swelling and some discoloration. These findings are common and do not indicate infection or other problems. Sleep with your head well elevated.

8. In case if severe bleeding, elevate head, apply ice to the back of your neck, and bite on a piece of gauze for 25 minutes, if the bleeding persists, bite on a wet teabag.

9. Do not hesitate to telephone if any question regarding your condition or operation arises. In an emergency, you should call us at our telephone number.

Recommended diet following implant surgery

Day 1: liquid diet, soups, high protein diet

Day 2: liquid diet, soups, high protein diet

Day 3: Puree diet, any food that can be blend well, mashed potatoes, soft boiled eggs, curd rice

Day 4: Puree diet, any food that can be blend well, mashed potatoes, soft boiled eggs, curd rice

Day 5: Puree diet, any food that can be blend well, mashed potatoes, soft boiled eggs, curd rice

Day 6 -14: Soft diet -boiled chicken, boiled vegetables, soup, and cheese.

Day 15 onwards – return to normal diet

FOLLOW-UP PROTOCOL

Follow up Visit No.1*:* - 24 hours post surgery

The following were the purposes of this visit

a. To ensure absence of immediate surgical complications
b. Wound debridement
c. Provisional restoration for 2 patients
d. Panorograph

e. Reference Digital Radiograph

f. Reinforcement of postoperative care and diet instructions

g. Keep the patient informed of the forthcoming follow-up visits.

Follow-up visit No 2: - 48 hours post surgery

a. To ensure absence of surgical complications

b. Provisional restorations for the remaining two

c. Make sure the superstructure or the restoration are not mobile and restoration was out of contact with the opposing dentition

d. Reinforcement of postoperative care and diet instructions

e. Keep the patient informed of the forthcoming follow-up visits.

Follow-up visit No.3*:* - 15 days post restoration

a. Ensure uneventful wound healing.

b. Evaluate the condition of the superstructure and restoration

c. Keep patient informed on forthcoming follow-up visits

Follow-up visit No. 4*:* - 1 month post restoration

a. To question the patient on his subjective symptoms, if any?

b. Make sure the superstructure or the restoration are not mobile and restoration was out of contact with the opposing dentition

c. Keep the patient informed of the forthcoming follow-up visits

Follow-up visit No.5*:* - 3 months post restoration

a. Subjective symptom evaluation

b. Condition of the restoration and superstructure

c. Abutment screw tightening and/ or replacement of the restoration when indicated

d. To keep the patient informed of the forthcoming follow-up visit

Follow-up visit No.6: - 6 months post restoration

a. Subjective evaluation

b. Final digital radiograph

c. Open-tray implant-level impression

d. Recementation of provisional

Follow-up visit No.7: - 6 months and fifteen days

a. Definitive superstructure connection

b. Definitive prosthesis delivery

c. Occlusal contact verification

PROSTHETIC PROTOCOL FOR DEFINITIVE RESTORATION

The temporary crowns and abutments were removed at the impression making appointment. The impression post was seated and the screw tightened using the Unigrip screw driver. The custom open-tray was tried in. The acrylic tray was then coated with silicone tray adhesive. Monophase addition curing silicone was syringed

and tray material seated in a single step. Once set, the impression post screw was loosened, and the impression pulled out in a snap. The impression post was removed along with the impression. The implant analog was snuggly fit on the coping and the impression post screw tightened to hold the analog in place. Type IV dental stone was poured to obtain a working model. The abutment was screwed and the temporary crown was cemented back in place in the patient's mouth.

On the working model, the impression post was removed and a suitable final abutment was screwed on to the implant analog model and milled. The wax pattern for metal framework was fabricated and cast. Appropriate shades of porcelain were fired in dentin and enamel layers and glazed to complete the final restoration.

DIGITAL RADIOGRAPHY TO EVALUATE CRESTAL BONE LOSS

The radiographic technique used in this study is a RadioVisioGraphic image using a long-cone (paralleling) technique with a Rinn positioning guide for making the X-rays. In the long cone intra oral periapical imaging technique, receptor and the object are parallel to each other. Owing to this parallelism, image shape distortion is minimized.

Both reference and final radiographs were made; reference radiographs, on the day of provisional restoration of implant and the final radiographs 6 months later. The final radiographs were subtracted from the reference ones to visualize changes in the periimplant crestal bone (assuming there is bone loss from the reference to six months postoperative). The resulting change in crestal bone level is visualized as a grey area

near the implant collar. The important point at this juncture is that the two images should have similar planar geometry to enable subtractive (reference-final) quantification of crestal bone loss. Movement of the film relative to the X ray source and/or movement of the film relative to the object should both be minimized to achieve similar planar geometries. Of the two errors, the movement of the X-ray source relative to the film is more damaging and cannot be corrected on an image analysis program digitally. This movement occurs preliminarily when the recline of the patient's head changes between the two examinations or when the cone angulation changes. The resulting image is a totally different cross section when compared to the preliminary one. The movement of the patient's head is minimized by using a head positioner and the cone angulations were noted and maintained for each patient.

The patients were seated comfortably on a minimally reclined dental chair with the head positioned on the head positioner designed for the purpose. The Rinn positioner along with the RVG sensor (*Kodak Dental Systems*) was positioned. The machine was set at 500mA and 220kV and a preliminary radiograph was exposed for 0.5 sec at a cone angulation of 40-50 degrees depending on patient requirements. If the resultant radiograph was satisfactory in detail, the position of the bite block in relation to the existing natural teeth was indexed with Additional Silicone Putty to ensure maximum positional reproducibility. Multiple images were secured for each patient at different time intervals in the same visit.

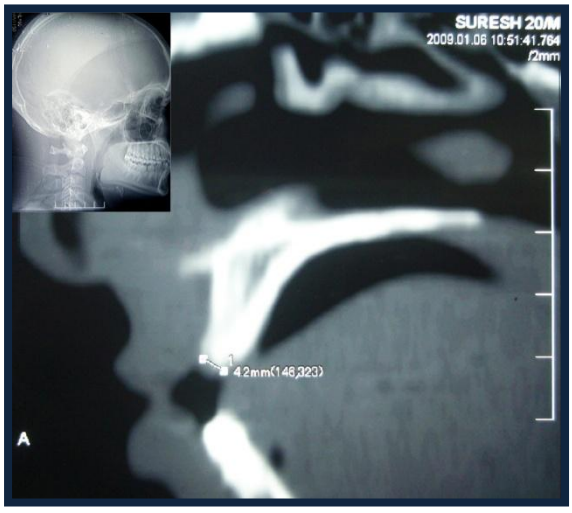
Two best-matched radiographs, one each from the reference and final radiographs were chosen for digital subtraction and image analysis using the software – Adobe Photoshop CS4 Extended. The two chosen images from each patient were adjusted

for brightness and contrast, i.e., the histograms of the two images were equalized to permit better visualization of the difference in crestal bone levels between the two radiographic examinations. The, the two images were adjusted and overlapped in two different layers. The two layers were subtracted using the calculations tool in the image menu of the program to determine the amount of crestal bone that has been lost during the stipulated follow-up period. The distance between two screws on the implant (0.75 mm) was taken as the reference to determine the scale of conversion in the image. The image reads on a pixels scale and the known value (0.75) is used to convert to millimeters. Both horizontal and vertical components of periimplant crestal bone loss were determined and averaged for the four patients on the mesial and distal halves separately. The vertical bone loss was determined in two different regions. One is the supporting bone loss near the implant and two, the vertical bone loss occurring at the crestal peak near the adjacent tooth. The horizontal bone loss was considered to stop at the level where the outline of the bone crest in the final radiograph takes a turn to meet the outline of the reference bone level.

The papillary fill in the mesial and distal interproximal regions were then determined using a dichotomous index, based on whether the papillary fill is complete or partial; to evaluate the esthetic outcome of the four restorations and correlate with the bone loss values.

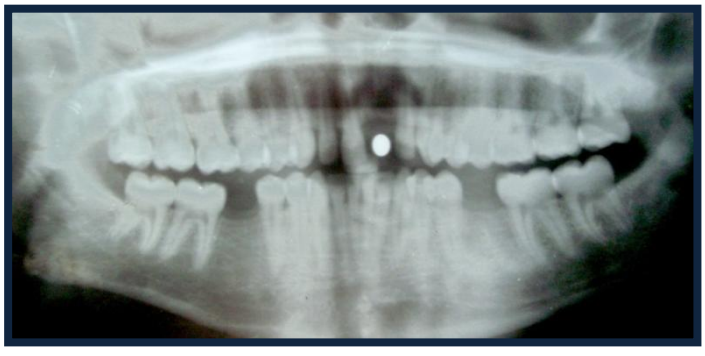
PHOTOGRAPHS

PREOPERATIVE PHOTOGRAPH



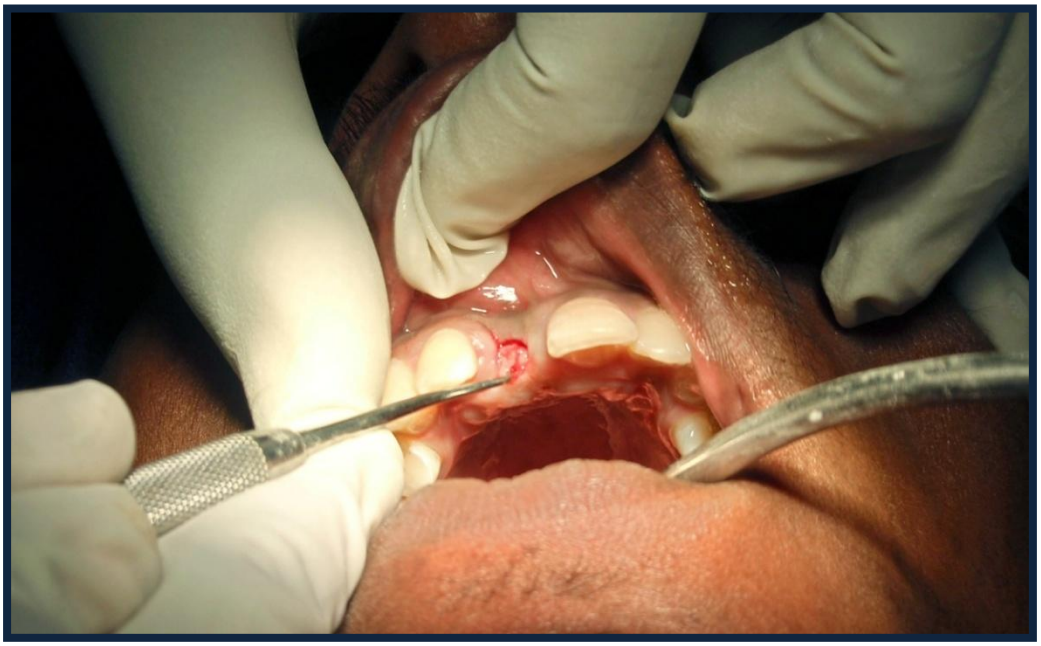
COMPUTER AIDED TOMOGRAPHY

PANOROGRAM

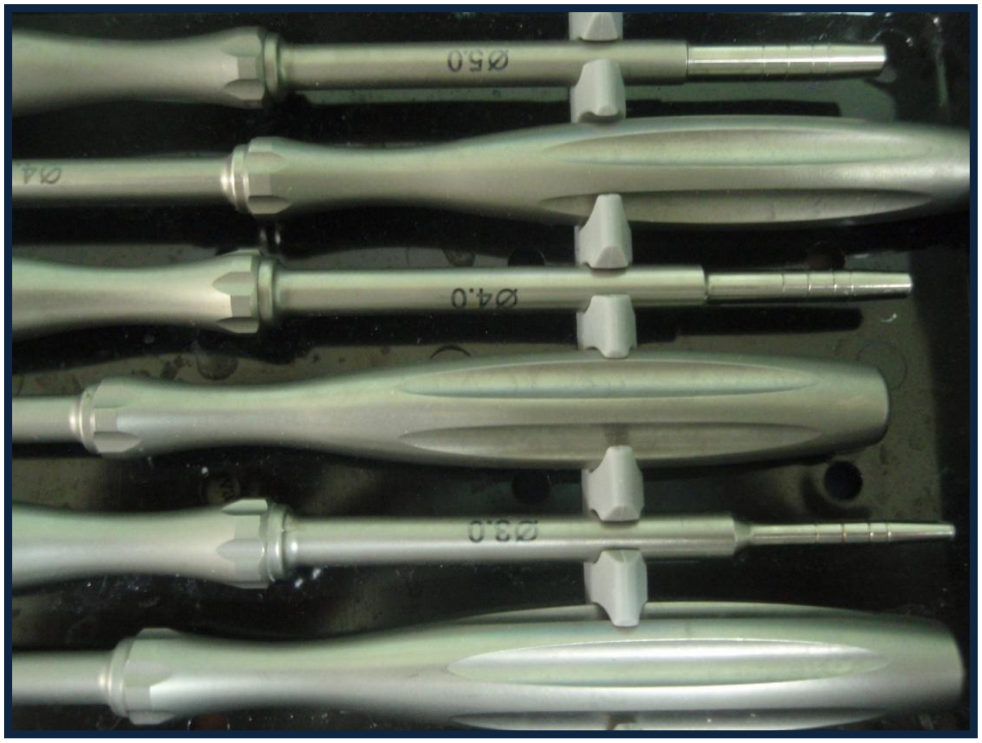


GINGIVAL PUNCH

CURETTAGE



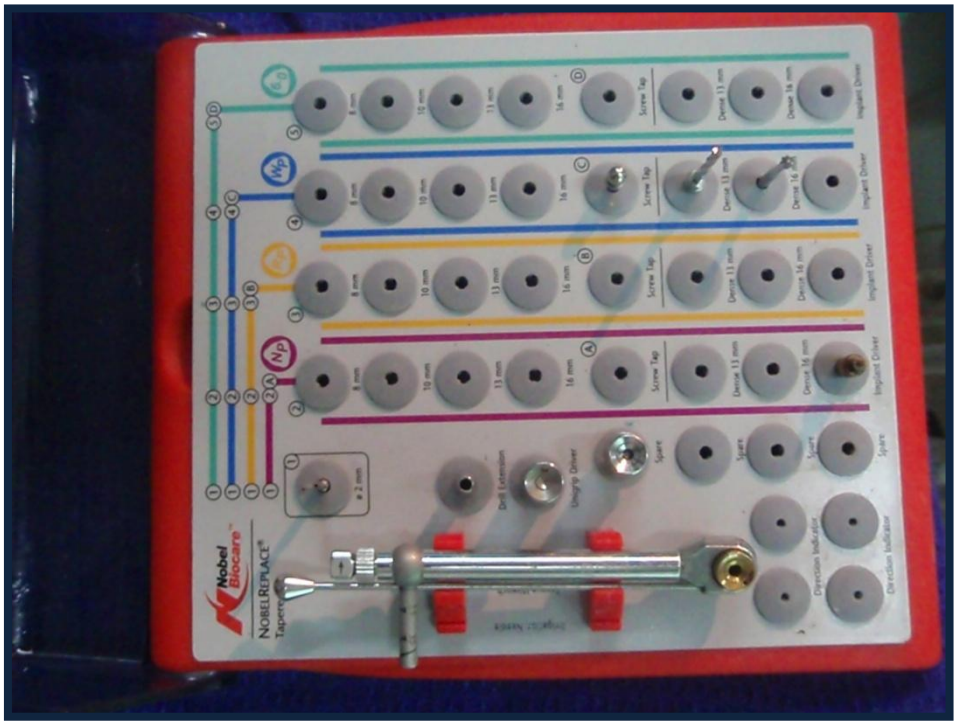
NOBEL BIOCARE -TAPERED OSTEOTOMES



OSTEOTOME TAPPED IN SITU

COMPLETED OSTEOTOMY

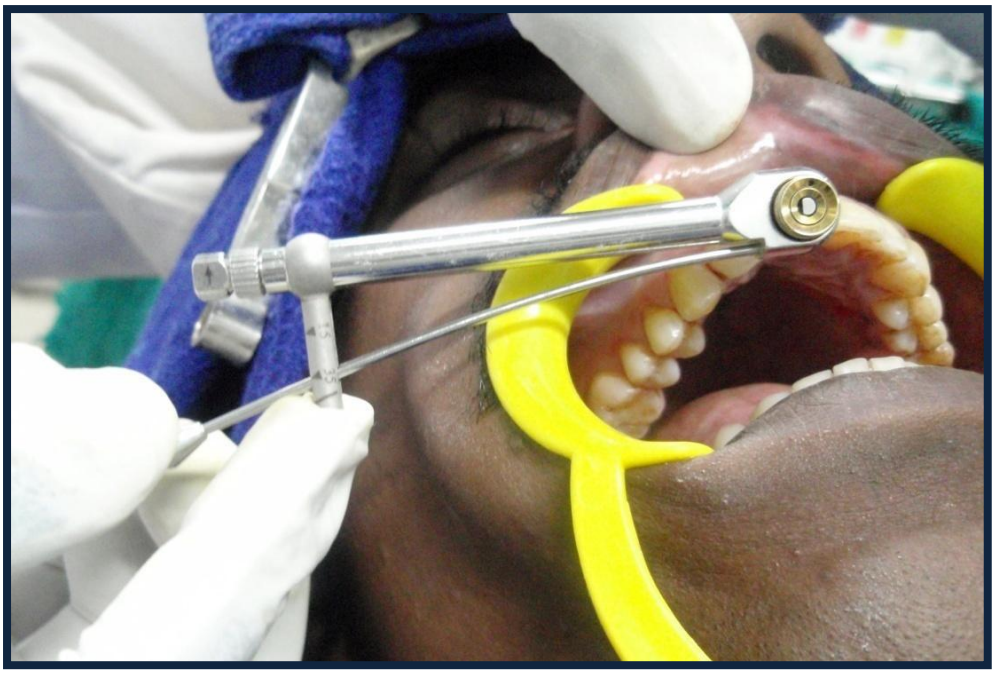
NOBEL BIOCARE – IMPLANT SURGICAL KIT



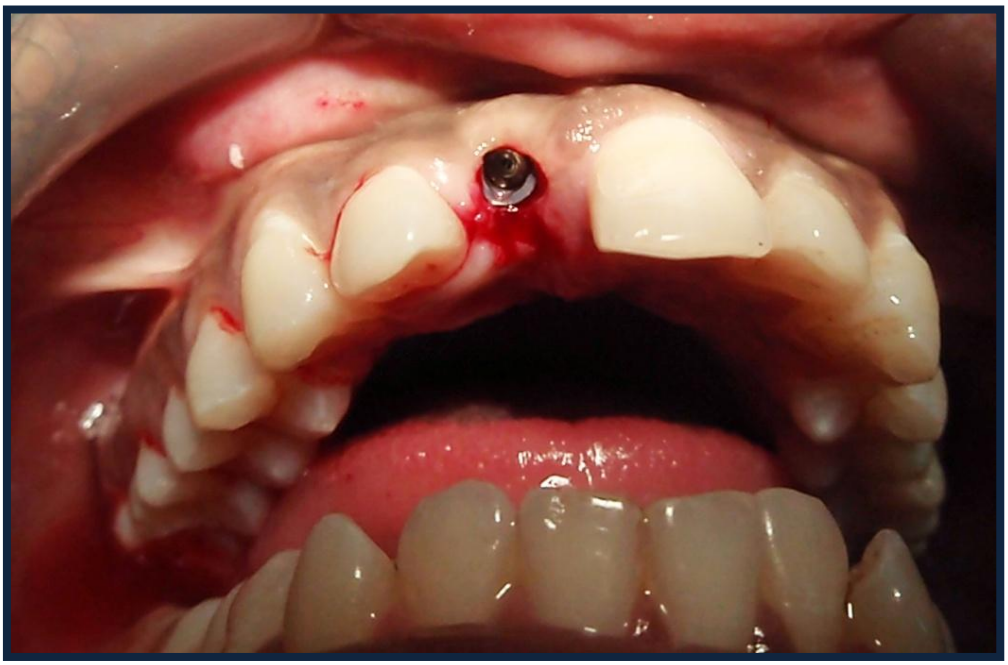
TORQUE WRENCH, IMPLANT HEX DRIVER & IMPLANT ASSEMBLY – NOBEL REPLACE SELECT TAPERED 3.5×16mm

IMPLANT IN THE OSTEOTOMY

MEASURING FINAL INSERTION TORQUE



IMPLANT IN POSITION

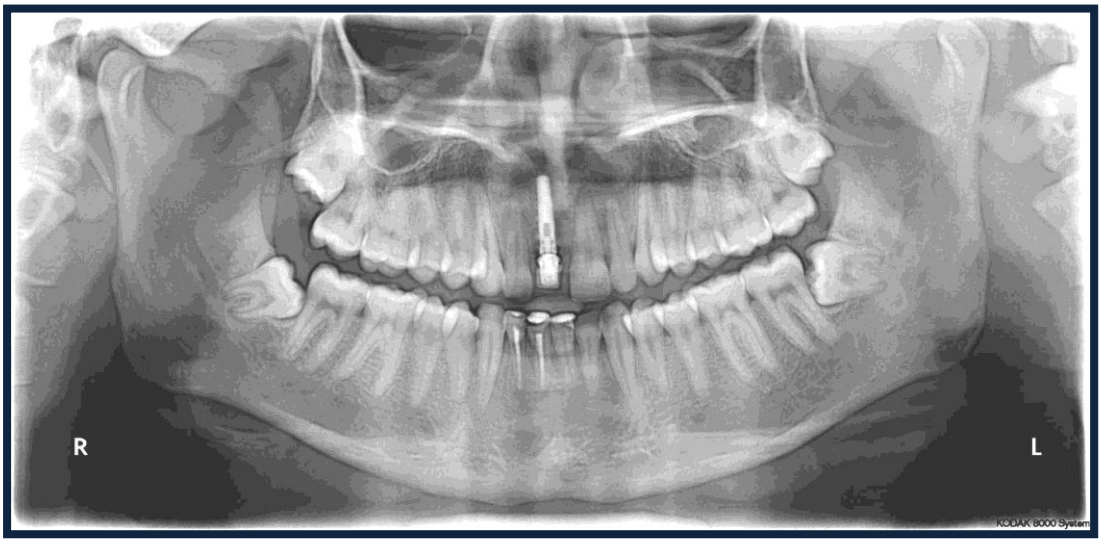


IMPLANT TRICHANNEL ORIENTAION ALIGNING LINES AND DOTS ON THE HEX

EASYABUTMENT– NOBEL BIOCARE

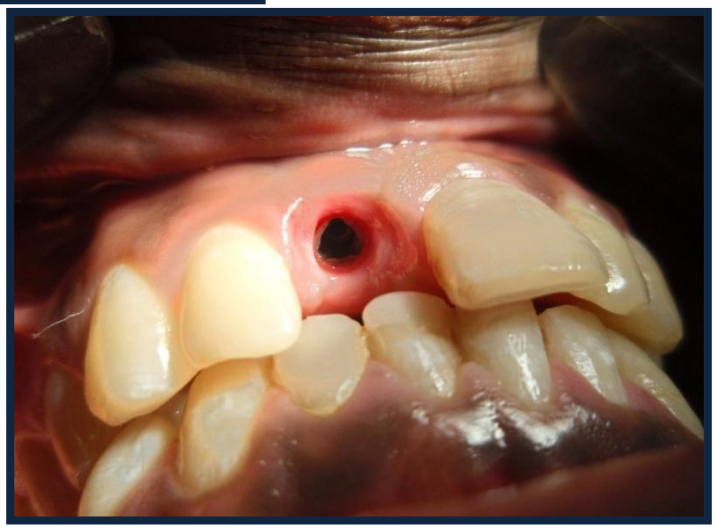
PROVISIONALCROWN

POSTOP PANOROGRAPH



SIX MONTHS POSTOPERATIVE

HEALTHY GINGIVAL CUFF



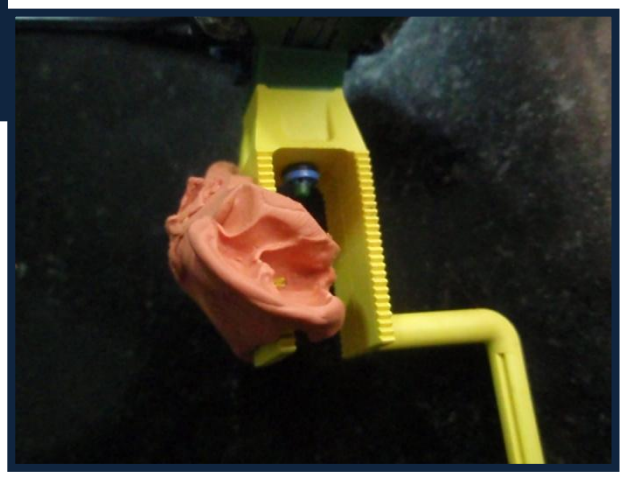
OPEN TRAY, IMPLANT LEVEL IMPRESSION

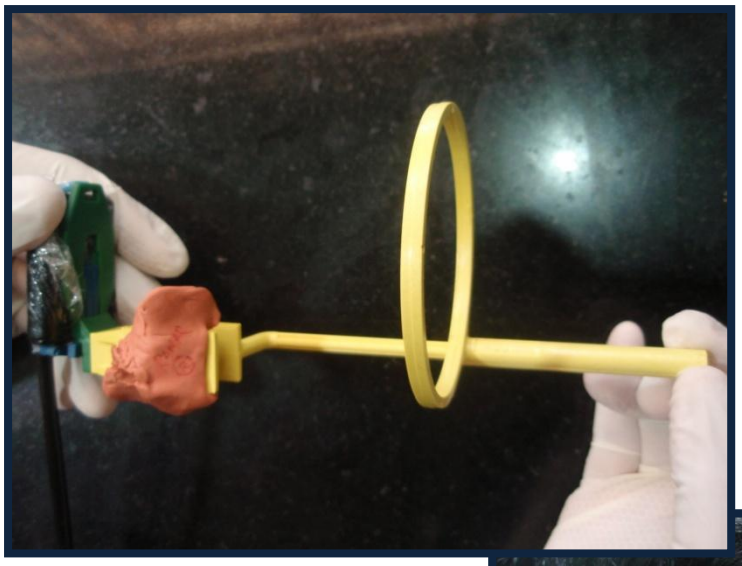
DEFINITIVE RESTORATION

PREOPERATIVE	POSTOPERATIVE
	
	
	
	

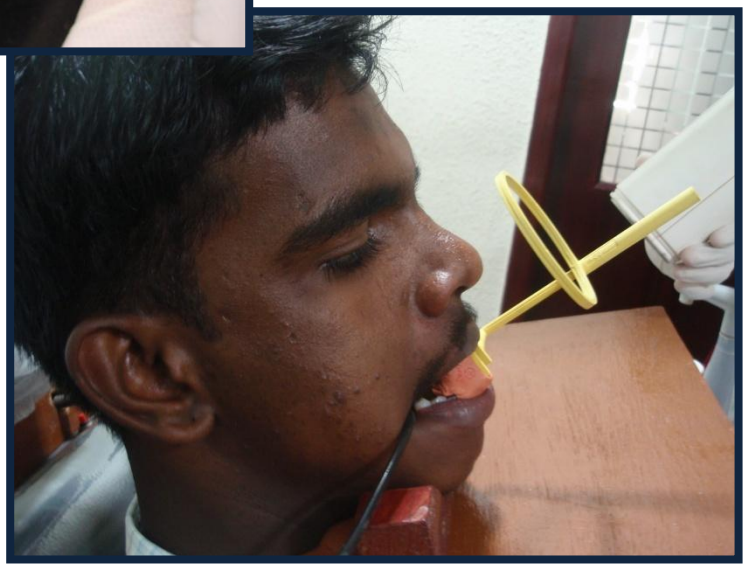
HEAD POSITIONER FOR DIGITAL RADIOGRPHY

RADIOVISIOGRAPHY SENSOR WITH BITE INDEX

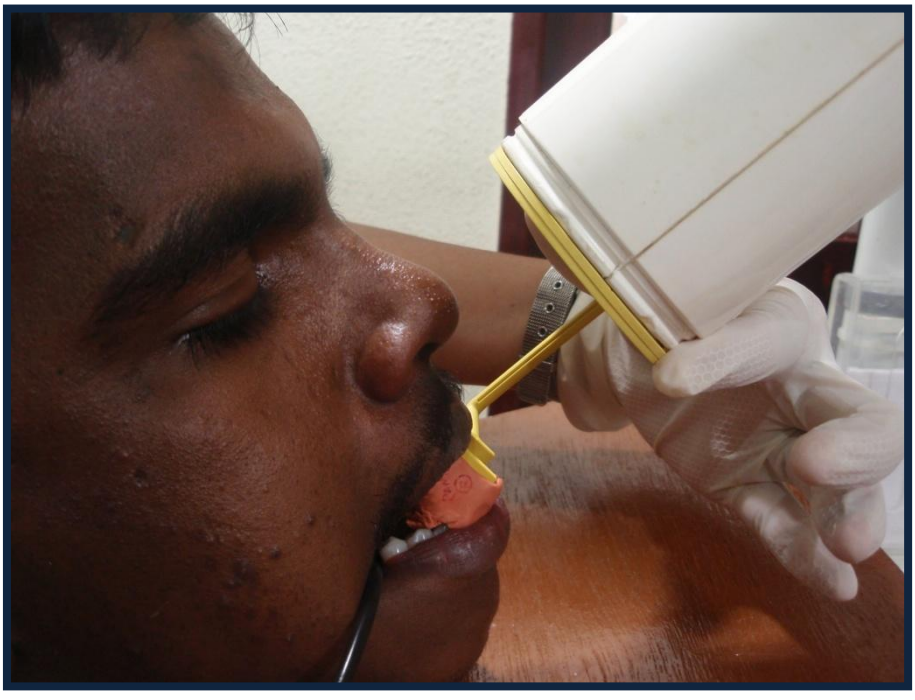




RINN POSITIONER ASSEMBLY



MAKING INDEXED RADIOGRAPHS

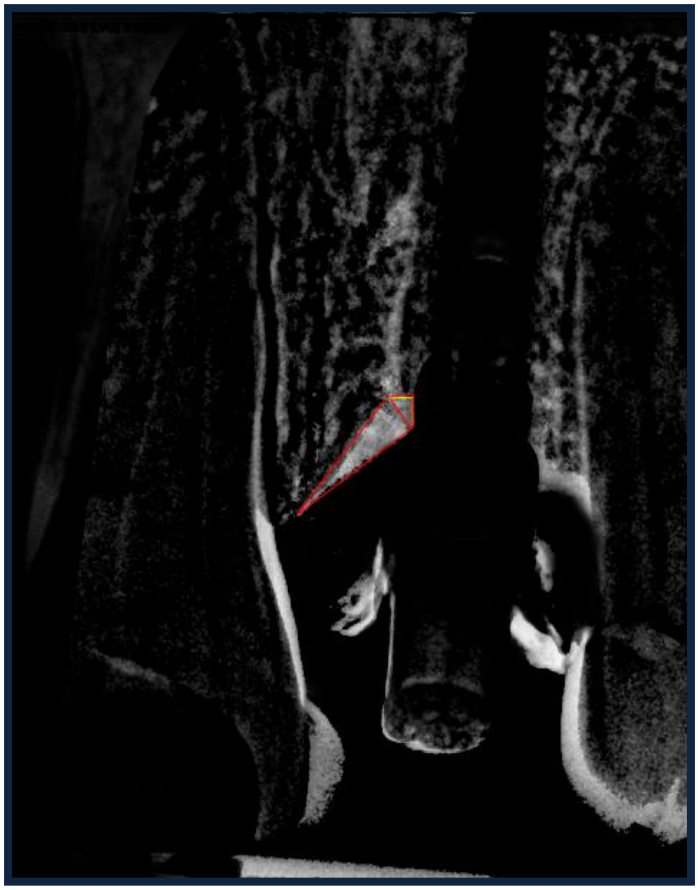


REFERENCE IMAGE

6 MONTHS POSTOP

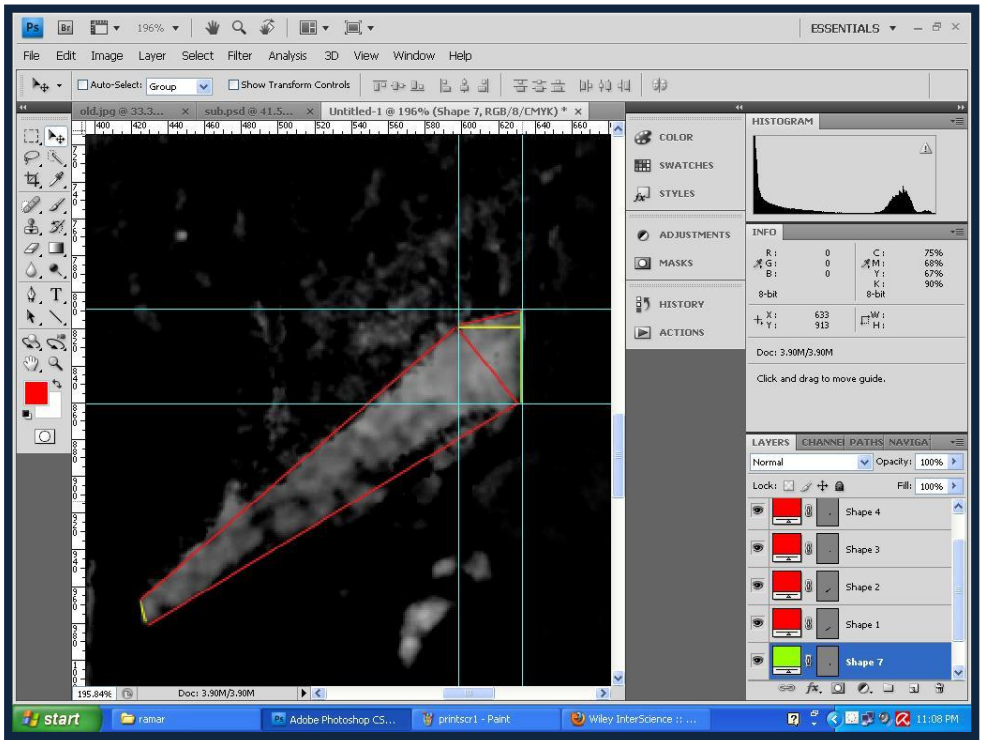
RADIOGRAPHS AFTER HISTOGRAM EQUALIZATION

SUBTRACTED IMAGE



**B= AREA OF BONE LOSS,
C = THREAD OF THE IMPLANT**

DETERMINING BONE LOSS TO SCALE



RESULTS

TABLE I – BONE LOSS, MESIAL AND DISTAL SITES

PATIENT NO.	BONE LOSS SITE	VERTICAL BONE LOSS (mm)		HORIZONTAL BONE LOSS (mm)
		NEAR IMPLANT	PEAK CRESTAL	
1	MESIAL	**2.80**	**1.01**	**0.36**
	DISTAL	**1.97**	**0.89**	**0.89**
2	MESIAL	**1.50**	**0.32**	**0.79**
	DISTAL	**0.25**	**0.50**	**0.25**
3	MESIAL	**1.15**	**0.00**	**1.04**
	DISTAL	**2.01**	**1.15**	**1.32**
4	MESIAL	**3.18**	**1.42**	**1.15**
	DISTAL	**-**	**-**	**-**

BONE LOSS LEVELS - MESIAL

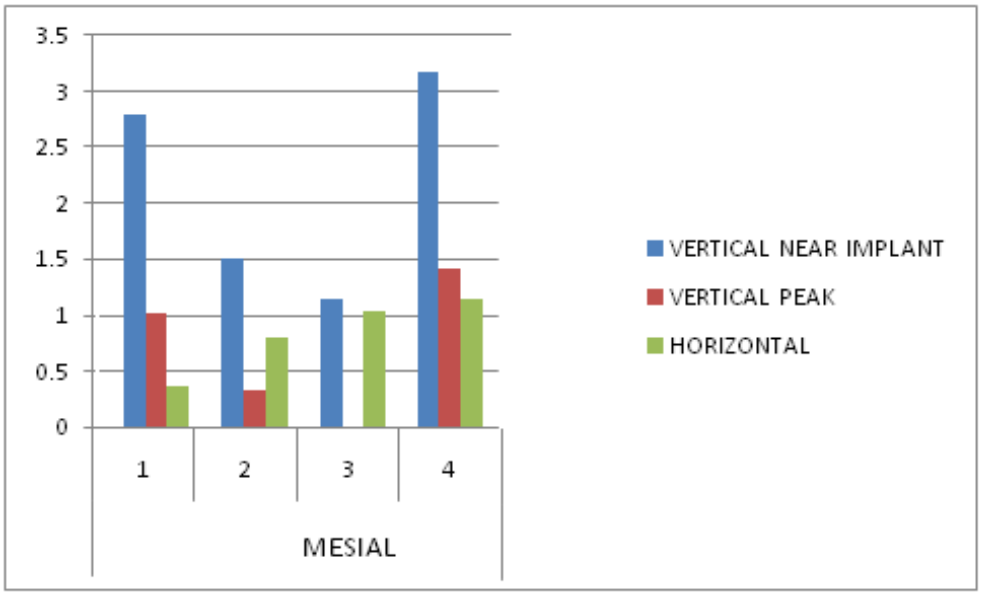


Fig 1A

BONE LOSS LEVELS - DISTAL

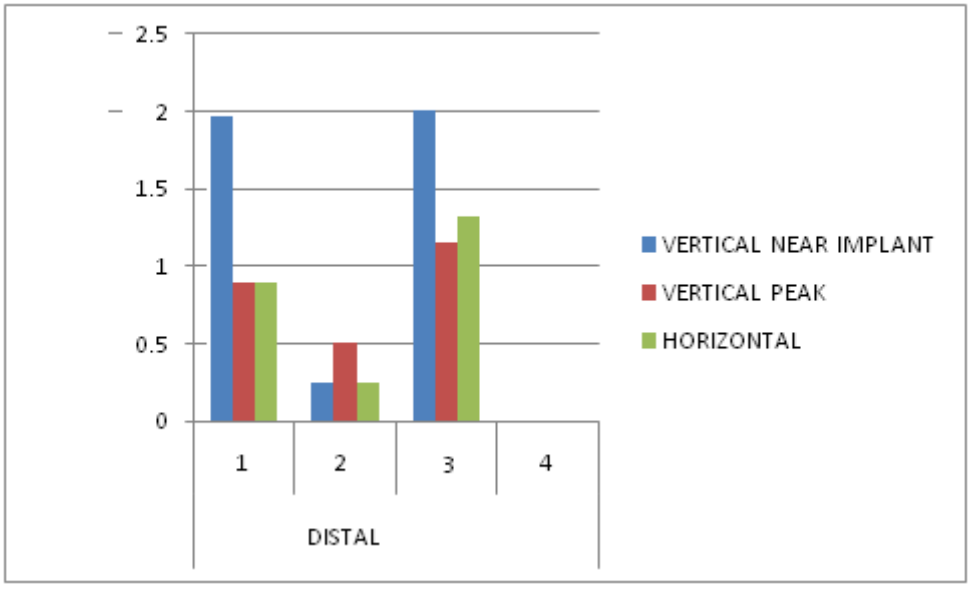
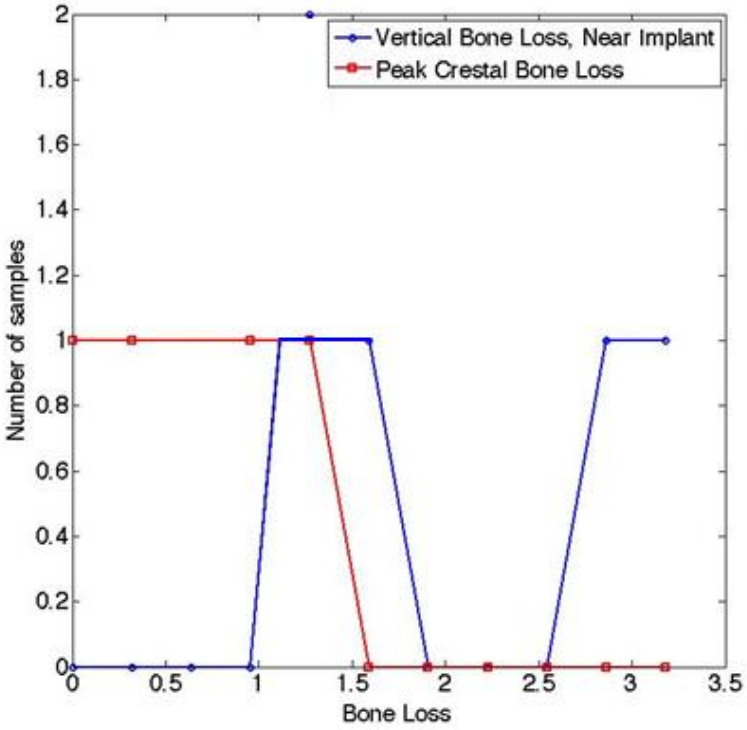


Fig 1B

Fig 2A



HISTOGRAM – VERTICAL AND CRESTAL BONE LOSS
Fig 2A – MESIAL, 2B – DISTAL

Fig 2B

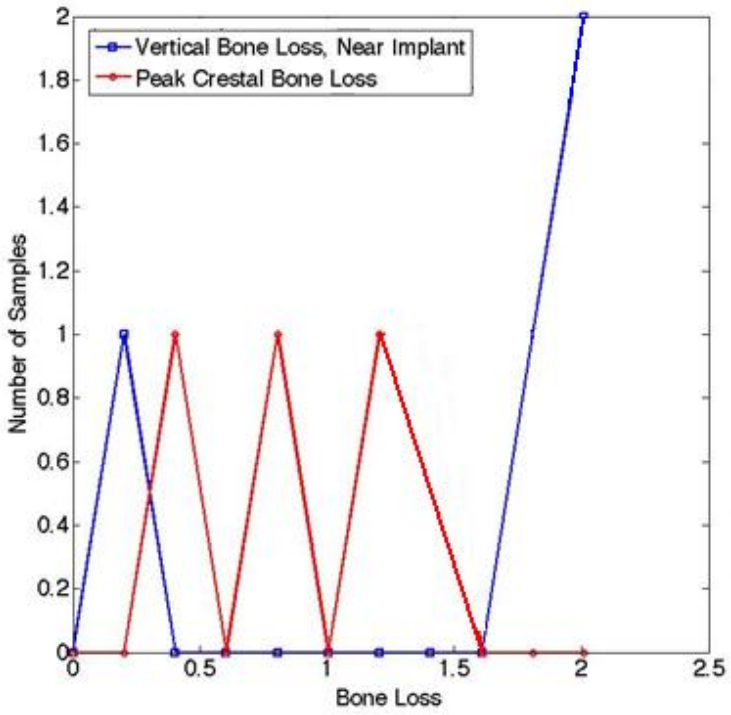
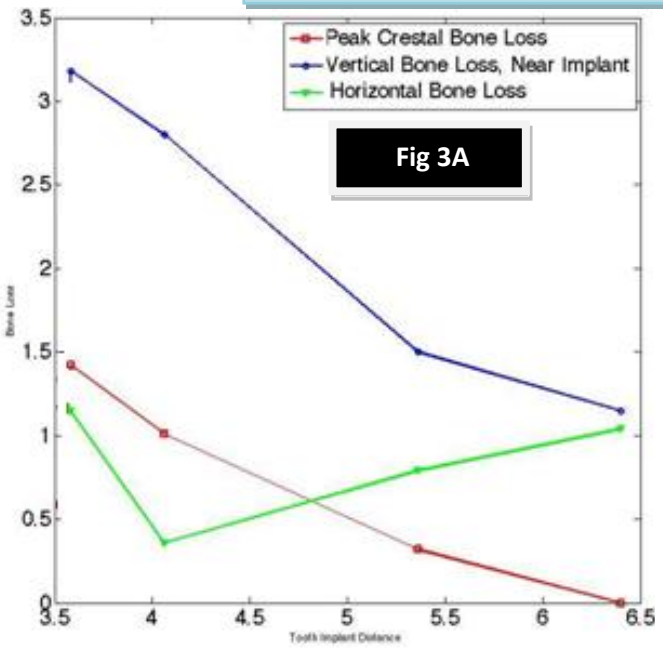


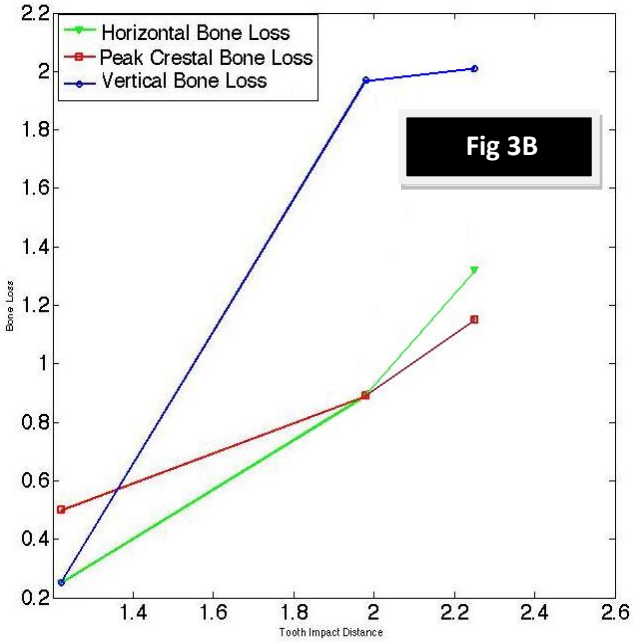
TABLE 2 – TOOTH IMPLANT DISTANCE

	TOOTH IMPLANT DISTANCE	TOOTH IMPLANT DISTANCE
	MESIAL in mm	DISTAL in mm
PATIENT 1	**4.06**	**1.98**
PATIENT 2	**5.36**	**1.22**
PATIENT 3	**6.4**	**2.25**
PATIENT 4	**3.58**	**0**

PLOTS – TOOTH IMPLANT DISTANCE Vs BONE LOSS



MESIAL



DISTAL

PATIENT NO	PAPILLARY FILL-COMPLETE OR PARTIAL	
	MESIAL	DISTAL
1	PARTIAL	PARTIAL
2	COMPLETE	COMPLETE
3	COMPLETE	COMPLETE
4	PARTIAL	COMPLETE

TABLE 3 – PAPILLARY FILL OF THE INTERPROXIMAL SPACE

INTERPRETATION OF RESULTS

At the end of the six month follow-up period;

a) All four implants were clinically immobile during abutment removal and impression making
b) The periimplant mucosa exhibited no signs of inflammation/ any exudate.

From there on

1. Considering 2 mm bone loss from reference as the accepted bone loss to grade an implant retained restorative protocol as totally successful with maximum periimplant health guaranteed as per 'The International Congress of Oral Implantologists Pisa Consensus Conference', the following patients and sites display more bone loss. All the other values lie within accepted limits.

PATIENT NO.	SITE	VERTICAL BONE LOSS NEAR IMPLANT (in mm)
1	MESIAL	2.80
3	DISTAL	2.01
4	MESIAL	3.18

2. The bone loss on the distal side of Patient no.4 could not be evaluated due to its closeness to the adjacent teeth.

3. The average bone loss in mm

	VERTICAL NEAR IMPLANT	PEAK CRESTAL	HORIZONTAL
MESIAL	**2.16**	**0.69**	**0.83**
DISTAL	**1.41**	**0.85**	**0.82**

4. There was no bone loss on the mesial crest of Patient No.3

5. Bone loss in the vertical direction was measured both near the implant and close to the alveolar crest of the adjacent tooth – peak bone loss. Histograms were plotted for comparison of these two values on the mesial and distal sides (Fig 2A,2B)

   The means of the vertical bone loss near the implant and peak bone loss on the mesial side were statistically distinguishable at less than 12% error. Sum of variance = 1.2354. There was minimal overlap of values from the two curves i.e. vertical and peak bone loss. (Fig 2A)

6. On the other hand, the two means on the distal side were statistically indistinguishable even at 25% error (Sum of variance = 0.2525) (Fig 2B). In other words there was considerable overlap of values in the peak and vertical bone loss values on the distal side.

7. Table 2 shows the tooth implant distance as measured on the intraoral periapical view on the mesial and distal aspects in each of the four patients. In

general, the tooth implant distances were greater on the mesial than distal surface. The implants for replacing maxillary central incisor, either 11/21; were invariably placed closer to the lateral incisor.

8. Judging from plots 3A and 3B, the bone loss in either the vertical or horizontal directions increased with increasing tooth implant distances on the distal side (Fig 3B)

9. Whereas on the mesial side (Fig 3A), the vertical bone loss near implant, peak crestal and horizontal bone loss increased with increasing tooth implant distances.

10. The papilla was present in all the four cases on the mesial and distal sides. When considering partial or complete fill, partial fill was observed on the mesial and distal sides of patient 1 and mesial side of patient 4.

DISCUSSION

DISCUSSION

IMMEDIATE RESTORATION PROTOCOL - THE BOTTOM LINE

Sufficient data are available to support the concept that immediately restored single-tooth implants in the esthetic zone can achieve osseointegration. When placing implants in the esthetic zone, stability of the soft tissue is of paramount importance. In general, literature indicates that once immediately restored implants integrate, they have bone and soft tissue stability comparable to those of conventionally loaded implants.

This protocol respects certain parameters for patient selection. Factors that have been highlighted to improve success rates include the absence of parafunctional habits, use of a roughened implant surface, use of a threaded implant, and most important, primary stability. Accordingly, the patient selection in this study protocol followed strict criteria in terms of adequate oral hygiene, age, bone quality and quantity, absence of bruxism and habits like smoking.

The cases selected in this study had buccolingual bone dimensions of 4-5 mm which would conventionally not suffice for optimal placement of a 3.5 mm diameter implant. Hence the protocol was modified to ensure adequate bone support on the buccal and palatal sides. These modifications include the use of osteotomes to expand the ridge in conjunction with a flapless surgery.

When a tooth is lost, blood supply from the periodontal ligament disappears, so that blood comes only from soft tissue and bone. Cortical bone is poorly vascularized and has very few blood vessels running through it, in contrast to marrow bone. When

soft tissue flaps are reflected for implant placement, blood supply from the soft tissue to the bone (supraperiosteal blood supply) is removed, thus leaving poorly vascularized cortical bone without a part of its vascular supply, prompting bone resorption during the initial healing phase. In a flapless technique, the intact blood supply from the soft tissue facilitates maintenance of nutrition, thereby preventing bone loss during the initial healing phase both from the buccal and interproximal sides. There are many advantages for the surgeon as well, since the procedure is less time consuming, bleeding is minimal, implant placement is expedited, and there is no need to place and remove sutures.[51]

Following flapless access, the access drill was used to initiate the osteotomy; the drilling was accomplished under external irrigation. To maximally reduce thermal necrosis, drilling is ideally accomplished under internal irrigation where the coolant reaches up to the tip of the drill. In this protocol external irrigation was considered sufficient as only a single drill was used and the bone density was of D_3 type. After access drilling, tapered osteotomes were tapped into place to expand the ridge in a buccolingual direction. This technique utilizes the viscoelasticity of bone to achieve expansion, thereby permitting the placement of a 3.5 mm (*N*p- Narrow Platform) wide implant with a minimum of 1 mm margin on either side in the buccolingual direction even in narrower ridges. This conservative preparation of the surgical site helped achieve adequate primary stability of the implant.

Another very important criterion in permitting the implants to be loaded immediately is adequate ‘Primary Stability’ measured in terms of ‘Final Insertion Torque’ of the implant. Torque, also called moment, is the tendency of a force to rotate an object

about an axis. One Newton centimeter is equal to the torque resulting from a force of one Newton applied perpendicularly to a moment arm which is one centimeter long. When a torque is applied to a dental implant using a wrench to seat it, the torque applied to the implant is a function of not only how hard the implant (i.e. the resistance encountered during application of the torque) is being pushed but, torque being a vector; also on how well it is being pushed in the right direction. The resistance encountered during the procedure depends primarily on i) the density of available bone at the site of osteotomy and ii) implant geometry. This forms the rationale behind the application of premature loading protocols even in areas of D_3 bone as in this study. D_3 bone is the one that is most often seen in the maxilla consisting of a thin cortical plate surrounding a loose-dense marrow. In this scenario, the implant geometry compensates for the lesser bone density. Clinically, the final insertion torque determines the '***Primary Stability'*** of an implant (as against secondary stability achieved after healing). If the final insertion torque is 32 Ncm, it implies that a torque equal or greater than this value is required to disengage the implant from the surrounding bone during the healing phase.

In this study, all the four implants were clinically immobile (CSR =100%) at the end of the six month period. This implies there are good chances of success with adequate treatment planning, incorporating as much clinical data as possible, and understanding the limitations imposed and modifying the implant placement protocols accordingly. One also has to weigh the risk-benefit ratio of an immediate load protocol. It is prudent to ask if the benefits gained from an immediate loading protocol are really worth the risk and if delaying restoration delivery puts the patient at a disadvantage.

However, long term follow up of a large number of patients are required to accurately predict the success of this protocol.

QUANTIFYING INTERPROXIMAL BONE RESORPTION

Bone loss in the immediate postoperative period occurs primarily because of two phenomena

1. Regional Acceleratory Phenomenon – a gradient of localized remodeling disseminating through the bone adjacent to any invasive bone procedure[C4].
2. Establishment of the biologic width around implants - The concept of biologic width in the recent years has also been applied to osseointegrated implants because soft tissues around dental implants exhibit relatively constant dimensions[34]. This biologic width comprises the zone of supracrestal connective tissue, approximately 1 mm and epithelial structures which measure about 2 mm.

3. The confounding factor in the immediate restoration protocol is –Muscular forces - the crestal bone is infringed by constant load from the musculature.

4. Usually, implant supporting bone resorbs down to the rough-smooth junction when the implant is exposed to the oral cavity and loaded. This is because the bone adjacent to the smooth region of the implant is subjected to shear loading. Bone is weakest under shear loads. The implant system used in this study, at a length of 13/16 mm has a smooth collar portion 1.5 mm in height.

A number of previous studies have assessed the success of the immediate restorative protocol based on the amount of bone loss occurring over a period of 6-60 months, on a two dimensional radiograph, either conventional or digital with bone loss ranging from 0.14 – 3.50 mm [3, 15, 22, 24, 26, 44,47, 52-54, 57,58,61,62]. Though most studies pertain to the success of this procedure in the anterior maxillary site, some studies include implants placed in both in the anterior and posterior sites of the mandible and maxilla. Interpretation of the results revealed lack of consensus on the reference points, the location and extent of bone loss determination in both the horizontal and vertical directions.

A few studies have calibrated the bone loss at the peak of the crest, and others have done so near the implant up to the first point of osseointegration on the implant surface as marginal bone loss in the vertical direction, and the distinction has not been clearly discussed. The consensus on the measurement of horizontal bone loss is even more obscure. The number of studies that take the horizontal bone levels into account is meager.

When bone levels are measured from a stable reference like the Implant Abutment Junction, it is qualified as positive or negative depending on the location of the bone in relation to it. Negative if the existing bone level is below the reference, towards the apex of the implant and positive if the bone is above the reference, towards the incisal edges of the adjacent teeth.

There also arises a difference in the timing of bone loss. It varies based on the level that is considered the reference either surgical placement or definitive restoration

delivery and decreases after the first year of loading. Last but not the least, the sample size; on averaging a larger one and eliminating values beyond the acceptable limit of 2.0 mm bone loss in the first year of function, the mean values obtained are much lesser than those observed in this study. These differences in methodology and a small sample size do not permit direct comparison of the results of this study with the previous ones.

However, one study[61] observed bone loss in the range of 0 – 2 mm which is close to the range observed in this study (0 - 2.80 mm). But the implants in this study were placed 0.3 mm above the crest. *Marco Degidi et al*[55] in their retrospective analysis of immediately restored single tooth implants found statistically significant supporting bone loss in maxillary when compared to mandibular sites. This factor could contribute to the increased mean bone loss observed in this study. *Kan et al* [47] observed similar 12 month bone loss values; however, they used a scalloped implant design.

In this study, two dimensional radiographs were taken at reference and 6 months and digitally subtracted. Only the interproximal bone can be visualized on a 2-d radiograph. To visualize bone on the facial side of the implant, a three-dimensional computed tomography scan is required. In a review of "Critical horizontal dimensions of interproximal and buccal bone around implants for optimal aesthetic outcomes" [68]; the authors concluded that "In the bucco-oral direction, there is insufficient evidence to set a threshold for minimal buccal bone thickness to ensure an optimal outcome."

Also *Boticelli et al*[9] in his study of hard tissue alterations following implant placement found no obvious relationship between buccal bone thickness or the horizontal distance between the implant surface and the outer side of the bone crest at implant placement and the amount of vertical bone resorption.

To top it all, because supra-crestal soft-tissues around implants seem to have relatively constant dimensions [the biological width], one could eventually hypothesize that a vertical buccal bone resorption will result in a marginal soft-tissue recession. In turn, this will influence the aesthetic outcome negatively [68].

DATA CORRELATION

- The bone loss for each patient was calculated in two directions, vertical and horizontal. In the vertical direction, the bone loss was designated as supporting bone loss near the implant and peak crestal bone loss. Histograms were plotted for the two values in the vertical direction on the mesial and distal sides to determine if their values overlapped. The values were statistically distinguishable on the mesial side. On the distal side there was considerable overlap. The peak crestal bone levels are to a greater extent influenced by the health of the periodontium on the adjacent natural tooth.
- In correlating the tooth implant distances and bone loss, horizontal and vertical, the vertical bone loss both supporting and peak crestal decreased with increasing interimplant distances. This is in concurrence to the data obtained by *Brigit et al* [11] which indicate that as the tooth implant distance decreases, the

marginal bone loss increased. On the same mesial side, the horizontal bone loss showed no such definite correlation. On the distal side, the vertical bone loss increased with increasing tooth implant distance. The reasons for this behavior are explained in the discussion on patient-wise bone loss. Current concepts require that a minimum of 3 mm tooth implant distance be maintained to ensure optimum periimplant health[67] and maintain the interproximal bone. When implants are placed at distances less than 3 mm, the horizontal component of bone loss merges at the crest to cause resorption that compromised the level of the interproximal papillae.

PATIENT-WISE BONE LOSS ASSESSMENT

The reference for the discussion of bone loss is taken from the James-Misch Health Scale (ICOI, 2008). Two out of four implants (Patients 2,3) can be classified under Group I – optimum health implants. One implant displayed bone loss of 2.80 mm (Patient 1) on the mesial side but had no other complications, was clinically stable and is classified under group II – satisactory survival. Even though the fourth implant (Patient 4) on a six month follow up period can clinically be classified under Group II, the long term prognosis of this implant may best be described as guarded due to misalignment of the implant in relation to adjacent lateral incisor.

1. PATIENT NUMBER 1

   The maximum bone loss for this patient is found on the mesial side of the implant in the supporting bone, measuring 2.80 mm. and the least in the horizontal direction on the distal side. The increased bone may again be attributed to the regional acceleratory phenomenon. The lesser levels on the distal side are probably due to the ideal distance between the tooth and the implant (2.0 mm)

2. PATIENT NUMBER 2

   The bone loss values for this patient were all within acceptable limits on both the mesial and distal sides; with the distal side values significantly lesser than the mesial ones. This phenomenon is observed despite the positioning of the implant at a distance of just 1.2 mm away from the adjacent tooth.

3. PATIENT NUMBER 3

   Interestingly, this patient exhibits increased supporting bone loss on the distal side. This is due to the fact that the implant was angulated with its long axis distally inclined causing the shoulder to be positioned subcrestally on the distal side and at the level of the crest on the mesial. This caused the bone to resorb to slightly below the implant shoulder in the six month interval amounting to a net bone loss of 2.01mm. Hence, as per the statements of *Daniel Buser et al*[16] *and*

E.Stein et al[8]; the apicocoronal positioning of the implant platform exerts a vital influence on the amount of vertical bone loss occurring around implants. Excessive countersinking leads to unnecessary loss of bone at the crest.

Also this patient exhibited no bone loss at the mesial peak of the crest. This in part may be attributed to the greater tooth implant distance of 6.4 mm on the mesial side but mostly to the optimal periodontal health of the central incisor tooth. Bone is maintained better by the periodontal ligament than an osseointegrated titanium screw.

4. PATIENT NUMBER 4

This implant showed no signs of mobility, inflammation or exudation after a six month healing period. However, the prognosis of the health of the implant can be described as guarded owing to 2 reasons – i) this implant has been placed dangerously close to its adjacent lateral incisor, negating the possibility of judging the distance between the two on the 2-d radiographic technique used in this study. The preoperative evaluation of this patient showed a mesiodistal width of 7 mm on a CT scan and a thick gingival biotype. *Arun K Garg*[7] recommended that a mesiodistal space of 6.5 mm would suffice to place standard diameter implants in maxillary anterior single tooth edentulous scenarios. But he also mentions that patients with a thick gingival biotype, have a flat periodontia and the roots are wider and less tapered.

ii) The supporting bone on the mesial side of this implant resorbed down to the pitch between the third and fourth screws amounting to a net bone loss of 3.18 mm. The bone on the mesial side is put under excessive strain and pathologically overloaded due to the lack of adequate support on the contralateral side leading to excessive bone loss as per Frost's mechanostat theory [14].

OPTIMIZING ESTHETICS

According to a review of outcome analysis of implant restorations located in the anterior maxilla by *Urs.C.Belser*[73]; scientific documentation of esthetically relevant and reproducible parameters is rather scarce. Most of the reported outcome analysis primarily focused on implant survival. The author stressed that elements of esthetic success should be included in future studies.

Therefore, in the present experimental study, the radiographic bone levels were used to qualify the health of the periimplant tissues and predict the future outcome of this treatment modality in terms of esthetic and functional parameters individually for the four patients

The buccal gingival margin in all four patients showed no signs of inflammation or recession and draped the final restoration without exposure of its margins to produce an optimal esthetic result.

A stable bone level around the implant neck is a prerequisite for achieving support and, hence, long term optimal and stable gingival contours. This is especially so with

regard to the interdental papillae in the anterior region. It is important to consider all the possible factors that may exert an influence within this sensitive region when designing an implant treatment plan to achieve an optimized functional/esthetic treatment outcome. Also, according to *Carl J Drago et al* [15] optimal esthetics for implant restoration in the anterior maxilla may be more difficult to obtain than implant osseointegration. The ability to predictably preserve or reproduce the interdental papilla is extremely important in the replacement of maxillary anterior teeth.

Papillary fill can be defined as the extent to which the interproximal area is filled with papilla under the contact point of the restoration. *Gastaldo et al*[79] was the first to attempt to correlate the presence or absence of papilla to the distance between teeth and implant. When a tooth to implant distance was 3-4 mm, a papilla was present in 75-88% of the cases and filled the interproximal space completely. If the tooth to implant distance exceeds 4 mm, papilla presence and fill were scored 56% of the times.

The best time for dichotomous evaluation (whether the papillary fill in the interproximal region is partial or complete) of the papilla is right before scheduling the patient for impression making, when the temporary is still present and soft tissue healing has progressed adequately. This reduces errors in assessment as the contours of the final restoration are built to compensate for tissue deficiencies to obliterate negative spaces in the interproximal region.

In this study all sites with a tooth implant distance of <2 mm showed complete papillary fill except for the distal site of patient 1. This may be attributed to the

excessive vertical resorption of the residual ridge with ensuing increase in crown length causing the contact point of the restoration to be at an occlusal position of greater than 7mm relative to the peak of the crestal bone.

The mesial sites showed tooth implant distances > 3.5 mm. Two patients showed complete fill and two patients showed partial – 50% presence. Patient 4 despite appropriate tooth implant distance on the mesial side, lost more tissue because of excessive bone resorption.

SUMMARY & CONCLUSION

SUMMARY AND CONCLUSION

To summarize the outcome of the Immediate Restoration Protocol in the esthetic zone using two-piece implants.

1. The Immediate Non Occlusal Restorative Protocol (INOL) using two piece implants in the anterior maxillary esthetic zone can achieve predictable success when the implants are placed with adequate primary stability (Insertion Torque ≥32 Ncm).

2. The success of the procedure also depends on astute case selection, avoiding factors that put the bone implant interface at risk of excessive micromotion; and adherence to strict surgical protocols.

3. Another important factor is meticulous patient follow up. It is imminent that the patient be highly motivated to maintain adequate oral hygiene; and incidences like dislodgement of the prosthesis and prosthetic screw loosening are attended to immediately to protect the health of the periimplant tissues and minimize the risk of failure.

In evaluating the extent of crestal bone resorption around these implants,

1. Crestal bone responds to a plethora of factors during the initial healing period before occlusal loading

2. In measuring crestal bone loss digital subtraction offers the advantage of highlighting the area of change and permitting direct visual assessment and

calibration. Even though standardization of the radiographs becomes cumbersome, benefits are attained in terms of accuracy and ease of measurement.

3. While attempting to measure periimplant bone loss, it is imminent that the position of the implant relative to the alveolar crest be carefully determined on the reference radiograph.

4. In a single stage protocol like the one used in this study the implant is exposed to the oral cavity right on the day of placement through abutment connection. The bone loss that occurs after Stage II surgery in delayed loading protocol occurs in the first few months in the single stage surgery. Therefore bone loss values seen in this study are acceptable.

5. In the immediate restoration protocol, the crestal bone is additionally subjected to muscular forces. Despite the muscular forces differing from patient to patient, the bone loss values for all the four patients showed a similar range.

6. The presence of natural teeth on either side of the implant in this single-tooth replacement scenario offers additional advantage in terms of maintenance of bone levels at the peak of the crestal bone.

7. The observations made from this study lead to the conclusion that the bone adjacent to a dental implant in the immediate postoperative period responds primarily to the position of the implant relative to the crestal bone on the day of surgery. Where the bone is 6 months later is always described in terms of where it started originally.

8. The bone levels exert a direct influence on the papillary fill in the interproximal region thereby influencing the esthetic outcome of the procedure. In other words, the 3 dimensional position of an implant has both a direct and an indirect influence on the esthetic outcome of an implant retained restoration.

9. Reviewing the protocol used in this study :

   Flapless surgery – Ridge Expansion osteotomy – Nobel Replace select tapered implant which is self threading – immediate restoration with the provisional prosthesis out of contact – Digital subtraction to assess crestal bone loss.

   To sum up, with well defined patient selection criteria and thorough preoperative patient assessment and treatment planning prior to the application of immediate restoration protocol for single tooth implants in the esthetic zone; the restorative dentist can be rest assured that the outcome of the protocol would be a success not just in terms of function but also in terms of preserving what exists in the periimplant region (both hard and soft tissue). This helps achieve the best possible esthetic result and thereby enhances patients' satisfaction to an enormous extent.

ANNEXE

INSTITUTIONAL ETHICAL COMMITTEE CLEARANCE

INSTITUTIONAL ETHICAL COMMITTEE
TAMIL NADU GOVERNMENT DENTAL COLLEGE AND HOSPITAL, CHENNAI - 3
Telephone No. 044 2534 0343
Fax 044 2530 0681

Ref.No.0421/ DE/ 08 Dated: 02.03.2009

Title of the work: Evaulation of crestal bone loss patients around immediately loaded stepped geometry frialit root form implants in the anterior maxilla

Principal investigator: Dr.R.Sridevi
Second year MDS

Department : Prosthodontics
Tamil Nadu Govt Dental College and Hospital,Chennai-3

The request for an approval from the Institutional Ethical Committee (IEC) was considered for the following remarks on the IEC meeting held on 02.03.2009 at the Principal's Chambers Tamil Nadu Government Dental College and Hospital, Chennai - 3

"Closed tray system is not correct. Open tray system can be used"

The Members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above , submitted by the principal investigator.

The principal investigator and their team are directed to adhere the guidelines given below:

1. You should get detailed informed consent from the patients / participants and maintain confidentiality
2. You should carry out the work without detrimental to regular activities as well as without extra expenditure to the Institution or Government.
3. You should inform the IEC in case of any change of study procedure , site and investigation or guide.
4. You should not deviate from the area of work for which you have applied for ethical clearance
5. You should inform the IEC immediately in case of any adverse events or serious adverse reactions. You should abide to the rules and regulations of the institution (s)
6. You should complete the work within the specific period and if any extension of time is required, you should apply for permission again and do the work.
7. You should submit the summary of the work to the ethical committee on completion of the work.
8. You should not claim funds from the Institution while doing the work or on completion.
9. You should understand that the members of IEC have the right to monitor the work with prior intimation
10. Your work should be carried out under the direct supervision of your Guide / Professor

12/03/09
SECRETARY

12/03/09
CHAIRMAN

IMPLANT SURGERY CONSENT FORM

The procedure has been explained to me and I understand what is necessary to accomplish placement of an implant. To my knowledge, I have given an accurate report of my health history.

I was informed of other methods to that would replace missing teeth. I have tried or considered these methods and I prefer an implant to help secure the replaced missing teeth. I understand that any of the following might occur: loss of bone, gum tissue inflammation, swelling, and infection. Also possible are joint problems, headaches, referred pain to the back of the neck and facial muscles.

The doctor has explained to me that there is no method to predict accurately the gum and bone healing capabilities in each patient following placement of an implant. I understand that smoking, alcohol, or departures from acceptable dietary recommendations may affect healing and limit the success of the procedure.

I agree to follow home care and diet recommendations. I agree to report for follow-ups as instructed. A reasonable fee will be made for these procedures. If for any reason, at the discretion of the Dr, it is deemed that the implant is not serving properly, it is agreed that the implant will be removed. It will be replaced with conventional prosthesis or another implant depending on the decision of the doctor.

I have been informed and understand that occasionally there are complications of surgery, drugs, anesthesia like pain, swelling, infection and persistent numbness. Also possible are inflammation of the veins, injury to teeth, bone fractures, nasal or sinus perforation, delayed healing and allergic reactions. It has been explained to me that implants may fail and must be removed.

Will full understanding, I authorize the doctor to perform services for me, including implants and other surgery. I agree to the type of anesthesia chosen, I agree not to operate a motor vehicle or other hazardous devices for 24 hours or until fully recovered from the effects of anesthesia or drugs given for my care, whichever is longer.

I authorize photos, slides, videos, x rays or any other viewing of my care and treatment during its progress to be used for the advancement of dentistry, I approve any modification in design, materials, or care if in the professional judgment of the doctor is in my best interests,

I understand that there is no warranty or guarantee as to any results. I am further advised that I can get additional information before or during the course of treatment merely by asking

The procedure and its risks have been explained to me by the attending dentist

DATE: SIGNATURE OF PATIENT

CASE RECORD

DEMOGRAPHIC DATA

NAME: *No.1*

AGE/SEX: **21/M**

ADDRESS: **13/8 Murugappa Nagar,**
Elango Street, Ennore Chennai – 600 057.

TEL NO (MOB): **-** **LANDLINE: -**

OCCUPATION: **Automobile Mechanic**

CHIEF COMPLAINT: **Missing upper front tooth.**

HISTORY OF PRESENT ILLNESS: **Loss of upper front tooth owing to trauma one year ago. Wearing a gum stripper for the past four months.**

DEMOGRAPHIC DATA

NAME: *No.2*

AGE/SEX: **20/M**

ADDRESS: **Dinathanthi Office, 86, E.V.K Sampth Street, Vepery, Chennai – 600 007**

TEL NO (MOB): **LANDLINE: -**

OCCUPATION: **Printing Press Worker**

CHIEF COMPLAINT: **Would like to replace his missing upper front tooth.**

HISTORY OF PRESENT ILLNESS: **Loss of upper front tooth one year ago owing to decay. Removable prosthesis usage for the past 5 months.**

DEMOGRAPHIC DATA

NAME: *No.3*

AGE/SEX: **22/M**

ADDRESS: **New Colony Street, Vayalappadi (POF Villa), Kunnam (T.k), Perambalur (Dist), 621716**

TEL NO (MOB): - **LANDLINE:** -

OCCUPATION: **Student**

CHIEF COMPLAINT: **Missing upper front tooth**

HISTORY OF PRESENT ILLNESS: **Lost owing to infection 2 years ago. No h/o prosthesis usage.**

DEMOGRAPHIC DATA

NAME: *No.4*

AGE/SEX: **22/M**

ADDRESS: **32/9, Kanagar Street, T.V.T, Chennai – 600 019**

TEL NO (MOB): - **LANDLINE: -**

OCCUPATION: **Welder**

CHIEF COMPLAINT: **Missing upper front tooth**

HISTORY OF PRESENT ILLNESS: **Upper left tooth lost due to trauma one and a half years ago. No h/o prosthesis usage.**

Dental Records

Oral Soft tissue examination – Patients 1-4

Lips:	**No Abnormality Detected except for patient No.2 with a notable High Labial Frenum**
Cheeks:	**No Abnormality Detected**
Tongue:	**No Abnormality Detected**
Floor of the mouth:	**No Abnormality Detected**
Palate:	**No Abnormality Detected**
Tonsillar area:	**No Abnormality Detected**
Any other:	**Nil**

Hard tissue examination

SIGNS	PATIENT 1	PATIENT 2	PATIENT 3	PATIENT 4
Caries:	Nil	48	Nil	45
Attrition:	41, 42; 31, 32	Nil	Nil	Nil
Abrasion:	Nil	Nil	Nil	Nil
Erosion:	Nil	Nil	Nil	Nil
Mobility:	Nil	Nil	Nil	Nil
Missing teeth:	11	36; 46; 21	21	11
Hypoplasia:	Nil	Nil	Nil	Nil
Impaction:	38, 48	Nil	38, 48	18;28;48
NonVital:	41, 42	Nil	Nil	Nil
Fracture:	Nil	Nil	11,22	Nil
Others:	Nil	Nil	Nil	Nil

Periodontal examination

PATIENT	GINGIVITIS	DEBRIS/CALCULUS	SOFT TISSUE RECESSION
1	† - MILD	† - MINIMAL	NIL
2	† - MILD	† - MINIMAL	NIL
3	† - MILD	† - MINIMAL	NIL
4	† - MILD	† - MINIMAL	NIL

Occlusal examination

PARAMETER	PATIENT 1	PATIENT 2	PATIENT 3	PATIENT 4
ANGLE'S CLASSIFICATION	Class I	Class I	Class I	Class I
OVERJET	1mm	1mm	1 mm	3mm
OVERBITE	4mm	1mm	1.5 mm	0.5 mm

RELEVANT MEDICAL HISTORY

QUESTIONNAIRE – PATIENTS 1-4

1. Are you suffering from any illness?	**NO**
2. Have you been hospitalized?	**NO**
3. Do you take medications on a daily basis?	**NO**
4. Are you currently pregnant?	**NO**
5. Do you have any of the following problems?	**NIL**

Heart disease
Circulatory disease
Diabetes
Liver disease
Rheumatism
Allergies
Kidney disorder
Thyroid disease
Seizures
Lung disorders
Gastrointestinal disorders
Nervous disorder
AIDS/HIV

6. Do you experience excessive bleeding or bruise easily?	**NO**

Investigations

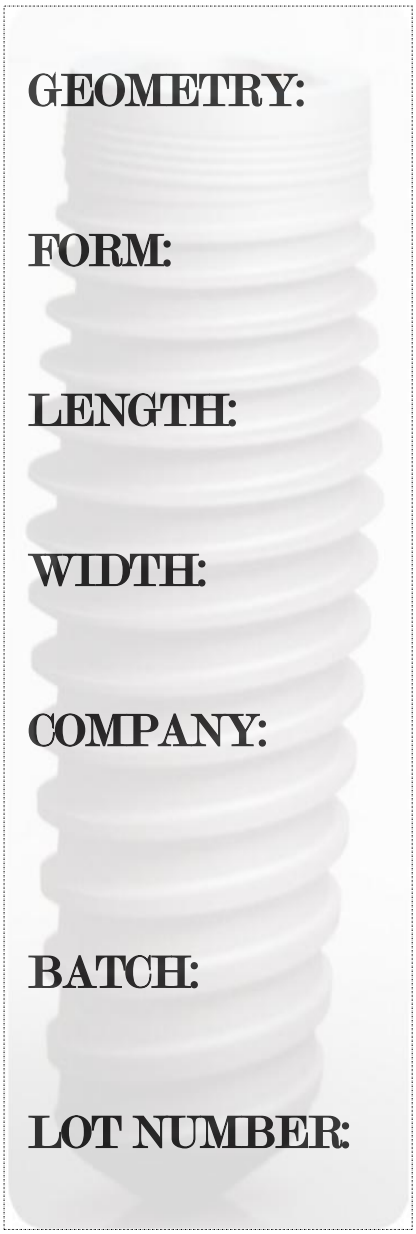
Routine Blood Investigtions

INVESTIGATION	PATIENT 1	PATIENT 2	PATIENT 3	PATIENT 4
Hb:	12.4 gm%	11.48 gm%	13.40 gm%	11.0 gm%
WBC Count:	8,050 cells/ mm^3	8,950 cells/ mm^3	10,900 cells/ mm^3	8,800 cells/ mm^3
Differential:				
PMN	68%	67%	69%	67%
L	30%	30%	29%	31%
E	2%	3%	2%	2%
BT:	2.50 min	2.50 min	2.50 min	2.20 min
CT:	5.30 min	5.05 min	5.30 min	5.05 min
RANDOM				
URINE SUGAR:	NIL	NIL	NIL	NIL
GROUP/Rh	B +ve	O+ve	A +ve	O +ve

Implant Investigtions

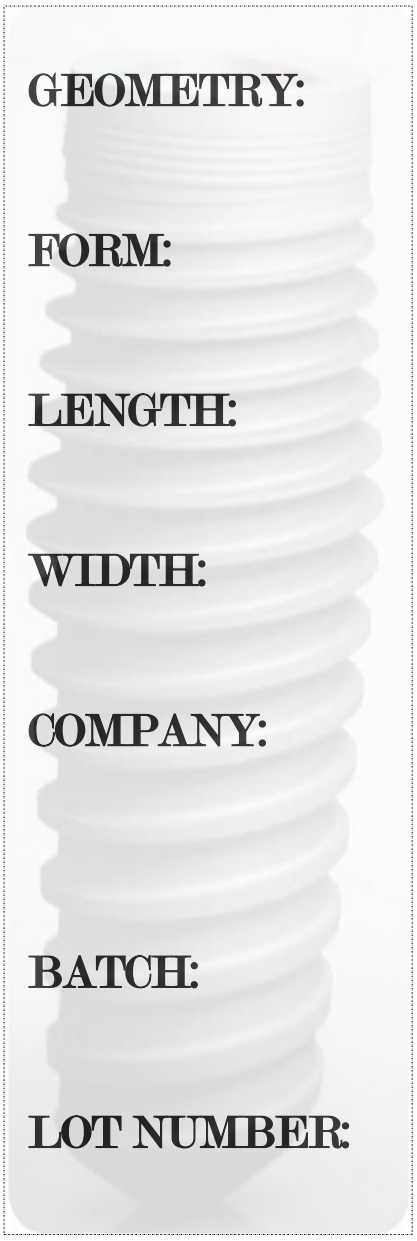
INVESTIGATION	PATIENT 1	PATIENT2	PATIENT 3	PATIENT4
OPG				
HEIGHT OF EDENTULOUS SPACE	**14.6 mm**	**21.0 mm**	**16.8 mm**	**18.5 mm**
WIDTH OF EDENTULOUS SPACE	**9.0 mm**	**9.6 mm**	**9.0 mm**	**7.0 mm**
CT SCAN				
BUCCOLINGUAL DIMENSION				
At crest	**4.8 mm**	**4.0 mm**	**4.7 mm**	**5.8 mm**
Middle	**7.5 mm**	**5.3 mm**	**7.0 mm**	**7.5 mm**
Base	**8.5 mm**	**8.8 mm**	**10.3mm**	**8.2 mm**
BONE DENSITY	**698.62 HU**	**612.00 HU**	**595.00 HU**	**686.94 HU**
CLASSIFICATION	**D3**	**D3**	**D3**	**D3**

IMPLANT SELECTION – Patient 1



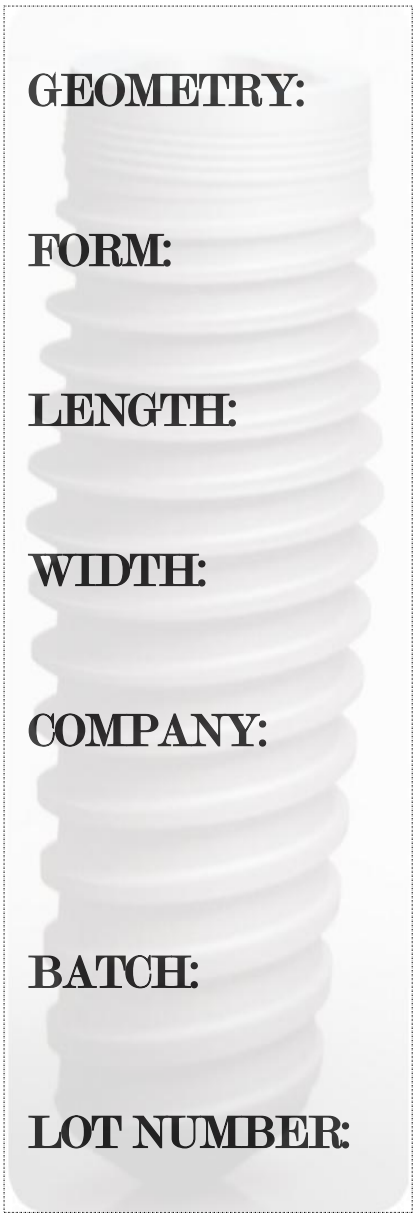
GEOMETRY:	TAPERED SCREW
FORM:	ROOT
LENGTH:	13 mm
WIDTH:	3.5 mm
COMPANY:	NOBEL REPLACE SELECT TAPERED
BATCH:	29402
LOT NUMBER:	393957

IMPLANT SELECTION- Patient 2



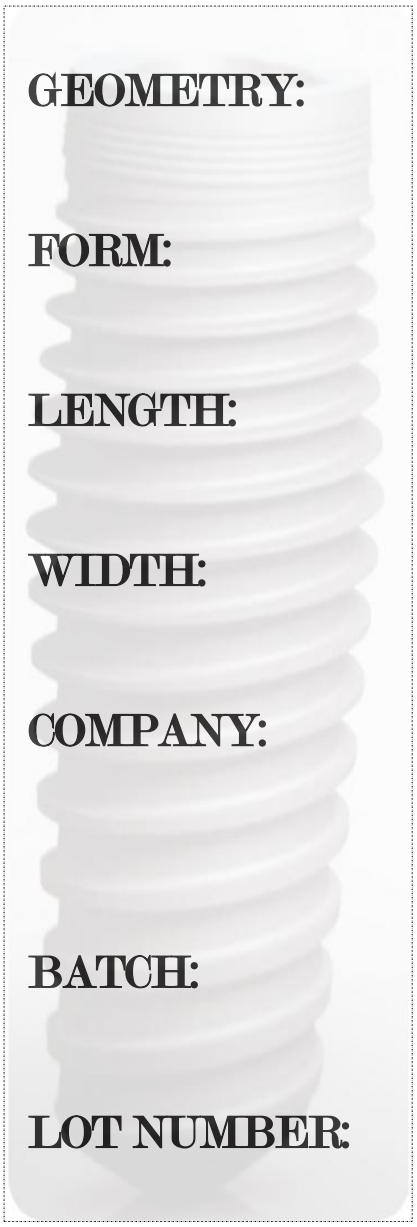
GEOMETRY:	TAPERED SCREW
FORM:	ROOT
LENGTH:	16 mm
WIDTH:	3.5 mm
COMPANY:	NOBEL REPLACE SELECT TAPERED
BATCH:	29403
LOT NUMBER:	401373

IMPLANT SELECTION- Patient 3



GEOMETRY:	TAPERED SCREW
FORM:	ROOT
LENGTH:	16 mm
WIDTH:	3.5 mm
COMPANY:	NOBEL REPLACE SELECT TAPERED
BATCH:	29403
LOT NUMBER:	406889

IMPLANT SELECTION – Patient 4



GEOMETRY:	TAPERED SCREW
FORM:	ROOT
LENGTH:	16 mm
WIDTH:	3.5 mm
COMPANY:	NOBEL REPLACE SELECT TAPERED
BATCH:	29403
LOT NUMBER:	401373

PRE-SURGICAL PATIENT PREPARATION

1. MOUTH PREPARATION

PATIENT 1

a. **Scaling and Polishing**

b. **Root Canal Treatment – 41,42**

c. **Composite restoration – 41, 42; 31,32**

PATIENT 2

a. **Scaling and Polishing**

b. **Removable prosthesis replacing 36,46**

PATIENT 3

a. **Scaling and Polishing**

b. **Composite restoration of 11,22**

PATIENT 4

a. **Scaling and Polishing**

2. PROPHYLAXIS

a. Antibiotics

Cap Amoxicillin - 1 gram per oral given one hour before surgery.

b. Anti-inflammatory

Tab Ibuprofen - 400mg per oral given one hour before surgery.

Post Surgical Phase

POSTOPERATIVE INSTRUCTIONS

1. Fill the prescription and follow the instructions on the label
2. Apply ice wrapped in a cloth to your face 10 minutes on and 20 minutes off for 48 hours.
3. To 1 quart of tap water, add 1 teaspoon of table salt, mix. Bring to boil, store in a covered container. Use as a gentle irrigant, 8 ounces each hour. Start tomorrow and continue until sutures are removed
4. Eat very soft foods as tolerated. They should be of high protein content.
5. For the first 24 hours postoperative, drink plenty of fluids, juice, soda, water, milk.
6. Take two tablespoons of milk of magnesia tonight
7. EXPECT A GOOD AMOUNT OF SWELLING AND SOME DISCOLORATION. These findings are common and do not indicate infection or other problem. Sleep with your head well elevate, even so, you will find swelling to be most marked on waking from the bed tomorrow.
8. In case if severe bleeding, elevate head, apply ice to the back of your neck, and bite on a piece of gauze for 25 minutes, if the bleeding persists, bite on a wet teabag.
9. Do not hesitate to telephone if any question regarding your condition or operation arises. In an emergency, you should call us at our telephone number.

RECOMMENDED DIET FOLLOWING IMPLANT SURGERY

Day 1: liquid diet, soups, high protein diet
Day 2: Same as day 1
Day 3: Puree diet, any food that can be blend well, mashed potatoes, soft boiled eggs, curd rice
Day 4: Same as day 3
Day 5: Same as day 4
Day 6 -14: Soft diet -boiled chicken, boiled vegetables, soup, and cheese.
Day 15 onwards – return to normal diet

SAMPLE IMPLANT FOLLOW UP FORM

Surgical Implant Date: 1.06.2009
Prosthetic Loading Date: 1.06.2009

Follow up: No.1 - 2 months later Date: 3.08.2009

1. IntraOral Photographs - √

2. Condition of gingival tissue: NORMAL
Normal/ Hyperplastic/ Inflammed/ Suppurative

3. Intra Oral Radiograph
Bone Loss - 0.5-1.0 mm - √
1.0-2.0 mm
2.0-3.0 mm
3.0-4.0 mm
√

4. Pain – None/Nocturnal/ Upon function/ Intermittent

5. Prosthesis
Debris - YES
Mobility - NO
Occlusion – NO CENTRIC OR ECCENTRIC CONTACTS

6. Treatment needs: NONE

Examiner's signature :
Date : 3.08.2009

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